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TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION

Introduction

The objective of this dissertation is to investigate the response to disasters by building a causal model of role performance in the operating system following disaster impact. The purpose of the introduction is to state the real world problem, the sociological aspects of disaster, how this research differs from previous disaster research and the objectives of the research.

Real world problem

Dynes, Haas and Quarantelli (1967:215) state that interest in disasters is not a new phenomenon, but the focus of contemporary interest is becoming quite different from that of the past. Many people still regard a disaster as a unique event, but more people and researchers are beginning to look at the disasters to see what they can tell us about the nature of disasters in general and about the validity of various theories about disasters and their impact. Researchers have just begun to search for explanations of the response of individuals, organizations and communities to emergency or stress situations which are believed to be structured in identifiable patterns of activity and sequences of involvement of individuals and organizations.

Disasters of numerous types have impacted man and his communities for centuries. Floods, earthquakes, fires, explosions, riots and hurricanes as well as other types of emergency situations have resulted in countless victims, destroyed homes and disrupted communities. In the past, some ways have been found to guard against some of the disruptive and disastrous effects of these forces. There has been, for example, considerable progress in controlling flood waters and predicting the weather.

At the same time that man was learning to control and better understand natural forces that might disrupt or destroy his communities, he was faced with the possible disastrous consequences of his own creations some of which are entirely new and whose effects are not well understood. These new forms of disaster include the possibility of nuclear attack on civilian populations as well as other man-made disasters such as airplane crashes or major fires. Civil disturbances are certainly not a new phenomena, but the consequences are often as devastating as other disaster agents.

Sociological aspects of disaster

In wartime, there has usually been no time to study the social consequences of invasions or bombings. In most cases, the energy as well as the available resources will be devoted to winning the war. Research in peacetime is also difficult. It has usually been necessary for the researcher to wait for the disaster to occur before investigating the impact on individuals, organizations or communities. As a result of these and other problems which the researcher faces, there have been few systematic, quantitative attempts to study the impact of disasters or explain the reactions which have been observed (Dynes, Haas and Quarantelli, 1967:215). Most studies such as Dynes (1969) or Anderson (1969a) have been merely descriptive case studies, attempts to reconstruct past events or presentations of sequences of events following a disaster. The research was not intended to test hypotheses or build theories to explain the responses of organizations and individuals.

Dynes, Haas and Quarantelli (1967:215) speak of disaster research in the following way:

> Fascination with disasters has produced a vast literature which attempts to describe or reconstruct these events. Any great catastrophe leaves behind it some public record--perhaps an eyewitness account, stories of heroism and tragedy which becomes part of the folklore, reports of official investigations and sound recordings. Such documents become part of the recorded history of a society and such events assume an important role in the total meaning of this history. We speak of something occurring before the flood or after the earthquake And certain names such as Pompeii or Hiroshima owe their immortality to this distinction. All of this suggests that disasters have been recognized in the history of man and that much of the material recorded attempts to understand the event itself and the reaction of people to it.

This "vast literature" has lead to the conclusion that it is possible that disasters or stress situations do recur in populations. Individuals, organizations and communities repeatedly face and must adapt to changing and often threatening agents in their environments. It is possible that there is a recurrent identifiable pattern of individual and organizational response to disasters or differing emergency situations rather than mere chaos. In addition, this pattern is believed to be stable enough or recurs often enough to be identified and studied with social science methods. It is the purpose of this dissertation to develop and test a systematic, empirical explanation of responses to disasters. In other words, patterns of disaster behavior will be considered as well as the response to disasters.

<u>How this research differs from past disaster research</u>

Research which investigates the impact of disasters or major emergencies is relatively new. The beginnings of this type of research is associated with attempts to understand the effects of war-caused emergencies upon the civilian population. There were a few rather scattered studies which appeared before the Second World War. However, Dynes, Haas and Quarantelli (1967) reported that the interest in and the number of disaster-related projects increased after the war. For example, the response to the massive bombings during the war was studied. The support for this research effort came from the American government. The British government, on the other hand, sponsored studies of the civilian responses to the mass evacuations which occurred during the World War II bombings of Britain.

Gradually, after the war, attention again shifted to the problems associated with natural disasters. The Opinion Research Center (Fritz and Marks, 1954) at the University of Chicago conducted a rather large scale project from 1950 until 1954. There have been other projects in this early period at rather widely scattered locations such as Ohio State University, University of Texas, Michigan State University and the University of Oklahoma. The disaster Research Group of the National Academy of Sciences--National Research Council is an important group because it sponsored numerous researchers and carried out many projects on its own. This group, however, was terminated in 1963. The Disaster Research Center at Ohio State University was formed shortly after the demise of this organization. The center at Ohio State has produced a considerable amount of research aimed at obtaining an understanding of the organizational response to natural disasters.

As noted earlier, there have been numerous attempts to study disaster reponse, and there has been considerable interest in disasters. However, there have been few attempts to systematically and quantitatively study disaster response or explain the behaviors which have been observed. Most previous research such as that at Ohio State University has been very descriptive in nature and the researchers at Ohio State have often used the "case study" method with participant observation and unstructured or semi-structured interviews recorded with a tape recorder. There have been few attempts to test hypotheses even though the work of Harry Estile Moore (1958) from the University of Texas does show some work utilizing rather simple statistics. The Disaster Research Center is not an organization which utilizes survey research techniques, and their work reflects this fact. The case studies and other reports and articles, however, indicate a number of fruitful areas and hypotheses for further investigation.

Haas and Quarantelli (1964:2) report that the major purpose of the Disaster Research Center is the study of organizations that are experiencing stress in order to determine how organizations change and fulfill their functions under difficult situations. Their interest appears to center on the fact that disasters create a breakdown in social relationships involving organizations as well as in the subsystems of the community. The crisis is thought to create problems of inter- and intra-organizational relations such as those of: 1) structure and operations, 2) circumstances that affect the ability of organizations to cooperate with each other, 3) the source of the capability for an organization to serve as overall coordinating body for disaster operations, 4) factors that maintain organizational continuity in spite of the disaster. The Disaster Research Center at Ohio State also engages in a considerable number of laboratory or small group simulations of response to stress.

The Disaster Research Center as well as most other disaster research groups tend to study response to disasters by on-the-spot interviews and observations soon after the disaster has struck. This technique has much to recommend it in terms of vividness of detail that can be observed and recorded, and by virtue of the fact that the respondents are familiar with the immediate effect of disasters. The technique also brings with it a number of problems, some of which will be presented below. The research reported in this dissertation differs from that of most other disaster research in ways that are pointed out.

Often the choice of the research case (type of disaster) has not been under the control of the researcher. Previous research has focused on observation soon after disaster impact. It has not been possible to foretell when or where the next disaster will strike. This factor has made it extremely difficult to plan research designed to focus on response to disasters. For example, it has been difficult to estimate the man hours that would be required to effectively analyze disasters. It would be difficult to plan a budget or know when to begin or when one could complete the research. Also, report writing might be made more difficult if new opportunities for data collection arise just as reports were being prepared.

On the other hand, the research techniques which were utilized in the research reported in this dissertation allowed the researcher to select his research cases from a list of those disasters which had occurred during a specified period of time. It was not necessary to be on the scene soon after the disaster even though in at least one case interviews were in the area within two weeks of the disaster. This technique made for efficient planning and budgeting. Of course, more demands were made on the respondents in terms of remembering events which had occurred some time in the past. The research, as carried out, was limited by factors generally associated with survey research.

Some disaster researchers such as Haas and Quarantelli (1964:8) have reported that there is often a lack of information for the research, especially accurate information, which tends to compound the problem of selecting research cases. This refers to the information which is necessary before a researcher or group of researchers can rationally commit resources. The information is often not available even in the technologically advanced societies such as the United States. Haas and Quarantelli (1964:8) reported that it has been necessary at the Disaster Research Center to set up a series of criteria to guide them in deciding when to commit interview teams to an area, but often the data needed to allow them to make decisions are not available due to the disruption of communication caused by the disaster.

The problem of available information was not completely resolved in this research even though disasters were selected which had occurred in the recent past. The major reason is that accurate information was not available about the severity of the disaster or information about who had operated or assumed roles that might contribute to recovery from the impact of the disaster. However, it was possible to set up criteria for inclusion of disasters and disaster coordinators in the present study sample. It was necessary for the coordinator to be located within a certain area, have been the coordinator at the time of the disaster, have received or expect money for a disaster from the Office of Emergency Preparedness, know or have knowledge of the fact that the area had been declared a disaster area and be judged to have assumed a role in recovery operations. The role involved activities such as working directly with operations personnel, participating in policy decisions affecting overall recovery operations or overall coordination of recovery operations. Additional information in regard to populations and samples selected for this study will be reported in a later portion of the dissertation.

Dynes, Haas and Quarantelli (1967:220) report that the Disaster Research Center has not had problems obtaining access to the organizations that they have studied, but they add that they are often identified with reporters from the mass media. The tape recorders and other devices that are carried tend to reinforce this idea among the personnel in the organizations being studied. The degree to which the researchers are confused with reporters could affect the information gathered.

The Iowa State University interviewers utilized in this research were not faced with the problem of mistaken identity because they came to the area after the disaster activity had occurred. They had cleared or legitimized their presence in the area through civil defense before their arrival.

Dynes, Haas and Quarantelli (1967:22) report that the Disaster Research Center researchers attempt to obtain a "Gestalt" of the communities' response to the emergency. They do this by interviewing, at a minimum, the head of the organization and the person in charge of operations at the time of the disaster. These interviews are expected to take place in the organization that is most directly involved in disaster related operations. They also attempt to interview at least one person in an organization that is less centrally involved such as the school system. The most central organizations are often the civil defense groups and the police or fire department. The researchers collect written reports and other records which pertain to such relevant topics as how decisions were made that affected recovery operations. Often, organizations which experienced the highest level of stress are chosen for more intensive study which may last up to one year.

It would, however, appear to be difficult to obtain a "Gestalt" view of community recovery operations through the study of one or a few organizations no matter how intensive the study. Also, the goal of obtaining this global view appears to conflict with the earlier report by Dynes, Haas and Quarantelli (1967:22) of the goals of the Disaster Research Center in which it was stated that the goals involved the study of intra- and inter-organizational relations. In the opinion of the present writer, inter- and intra-organizational relations do not necessarily provide a "Gestalt" view of the community.

The present interest was in the response of civil defense and the information that was obtained through interviews about other organizations is always from the point of view of the civil defense coordinator. The civil defense coordinator alone was interviewed and no intensive study over a long period of time was attempted.

The researcher who wishes to do research on the response of organizations to disasters has the problem of defining the population. If an organization is the unit of analysis, how is a sample to be drawn once the population is specified? This is a major problem for the organizational boundaries are often blurred as a result of the effect of the disaster. Often, there is also the partial emergence of an ad hoc organization to coordinate the recovery related operations in the community. This organization disappears after recovery. Even if the research utilizes the individual as the unit of analysis, the problem of obtaining an adequate sample may be extremely difficult to solve due to the fact that homes have been destroyed and people have left the area temporarily.

The population and sample used in the present study will be discussed in a later chapter of this dissertation.

The reports of the Disaster Research Center as well as that of most other disaster research groups has resulted in little more than descriptions of sequences of behavior of individuals and organizations observed following the disaster (Barton, 1969). One alternative, reported by Drabek (1970:333), is to view community organizations as designed to accomplish a system of specific goals. Following this suggestion, Quarantelli and Dynes (1970) edited the special January-February issue of the American Behavioral Scientist which contained a series of articles or case studies of different organizations such as the police, fire department, Red Cross and public works departments.

Drabek (1970:333) further suggests that one might review descriptive accounts and use these as the basis for quasi-hypothesis testing. Better yet, Drabek suggested that a person might develop a "theoretical" causal network and use this to collect data. The data could be utilized to evaluate tentative models of behavior in disasters. A similar suggestion calling for the need for models was made by Brouillette and Quarantelli (1969) and by Barton (1969). This alternative was chosen for the study reported in this dissertation. The research is exploratory in that there has been no known previous attempts to build causal models to explain response to disasters.

Objectives of the dissertation

In light of these observations, two points appear appropriate for emphasis and consideration. First, little quantitative research has been done on the social impact of disasters. Second, there is a need for a theoretical framework and data to answer some of the questions raised by earlier research in regard to effective recovery from the effects of disaster. The primary purpose of this dissertation is to build and evaluate a tentative model of role performance response to disasters. To meet this general objective, the following more specific research tasks will be performed:

1. Identification of concepts at a theoretical level which are related to role performance in an organizational response to disasters.

2. Development of empirical measures of the relevant concepts that have been identified.

3. Building of an adequate causal model to explain role performance of local coordinators following disasters.

4. Discussion of some implications of the present research and suggestion of future disaster research which should be considered.

In order to achieve both the general and specific objectives, the following order of presentation will be followed in this dissertation.

Chapter 2 will focus on a review of relevant theoretical and empirical literature related to response to disasters. Concepts and propositions will be identified and ordered in a causal model representing role performance in the operating system following the impact of disasters.

Chapter 3 will focus on the research population, sample and operational definitions of the concepts developed in Chapter 2. The procedures for scaling the variables will be examined. The techniques and assumptions associated with path analysis will be presented. Two sets of recursive regression equations are introduced to mathematically represent the causal models developed in Chapter 2.

Chapter 4 will focus on the findings from empirical evaluation of the models. Two models will be evaluated utilizing path analysis techniques. The significant paths will be determined, direct effects, total indirect effects and residual paths will be quantified. A comparison of the two alternative causal models on the basis of eight criteria will be made to determine which model is more acceptable.

Chapter 5 will focus on the implications of the research for sociological theory, research methods and future research.

Chapter 6 will summarize the entire dissertation.

CHAPTER 2. THEORY

Introduction

It is the purpose of this chapter to present a theoretical framework for the analysis of role performance following a disaster. A review of the literature designed to analyze the response of individuals and organizations to stress situations is presented. A set of concepts will be identified and defined. Tentative conceptual models are suggested. The models will consist of a set of propositions involving a number of concepts.

It should be pointed out that the purpose of the chapter is not a comprehensive review of the literature or a statement of empirical hypotheses but rather a presentation of some past research and a theoretical framework suggesting relevant concepts, propositions and issues. The writer wishes to present concepts and build models based upon this literature which might allow eventual explanation of the behavior of individuals and organizations following a disaster. As noted in the Introduction, there are no existing comprehensive statements of theory at present which would allow the writer to easily draw propositions and concepts for empirical tests or for model building. Also, little empirical research is available. The present study is, in that sense, exploratory.

Building versus operating systems

In analysis of an organization, a decision must be made regarding which system(s) is to be utilized as a framework for analysis and discussion. Roland Warren (1963) has identified one dimension with patterns that appear useful, and S. D. Vestermark (1968:6) suggested another dimension which, when cross classified, will permit the discussion of four social systems each with differing role expectations for an organizational participant.

Roland Warren (1963:13) identified two basic patterns in the community that constitute the first major dimension. The first is the "horizontal pattern" which is defined as "the structural and functional relations of the various local units (individuals and social systems) to each other." The second dimension is the "vertical pattern" which is defined as the structural and functional relations of various community social units and subsystems to extra-community systems. The term "vertical" is used to reflect the fact that such relationships often involve different hierarchical levels within the extra-community system's structure of authority and power (Warren, 1963:161). Although differing levels may be found in the vertical system, the horizontal patterns are roughly without hierarchy. Warren (1963) utilizes the term "pattern" to refer to a particular type of relationship found in any community each of which will have differing goals, demands and norms. Warren (1963:162) points out that the vertical-horizontal dimension refers to a similar distinction made by George Homans between external and internal systems.

Another major dimension will be suggested. The first dimension as identified by Warren is concerned with building a capacity to respond to emergency situations. The second dimension refers to actual operations during or following an emergency. Vestermark (1968:6) states:

> ...In general, the <u>building system</u> is the civil defense countermeasures program in peacetime, as it is being planned, constructed

> and readied for crisis or wartime use. Part of the building system is paper plans, part is training, part is countermeasures systems under construction, stockpiling or skeleton maintenance conditions. On the other hand, the operating system is the established civil defense program as it functions (or is estimated to function) in crisis, attack, or war, at whatever degree of readiness it has been possible to achieve.

Haas and Quarantelli (1964) imply the existence of a building and an operating system in their discussion of organizations under "normal" and organizations under "stress" conditions. Thus, the operating system is concerned with organizational functioning during or after a disaster of some type.

The two major dimensions which have been identified were cross classified (Mulford et al., 1971) resulting in four systems which may be used for analysis of response to disaster. Figure 1 illustrates the four systems that result from the cross classification.

	Building System	Operating System
Vertical System	Building-Vertical	Operating-Vertical
Horizontal System	Building-Horizontal	Operating-Horizontal

Figure 1. Systems utilized for analysis of response to disaster.

There has been much research focusing upon the building system (for civil defense) in both the vertical and the horizontal systems such as Klonglan et al. (1968), Mulford (1970) and Mulford et al. (1971). Much of this research has been conducted at Iowa State University. However, much of the research on the operating system has come from the Disaster Research Center at Ohio State University. Little research has been conducted relating the systems together. Figure 2 is an attempt to illustrate a proposed relationship between the building and operating systems.

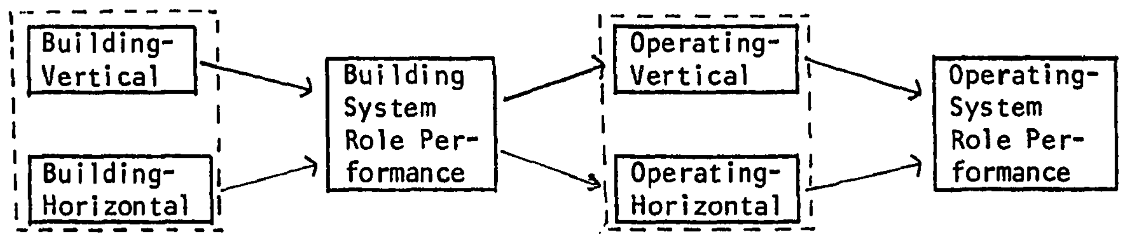

Figure 2. Relationship between the building-operating systems and role performance.

One means of clarifying the relationship between the systems is reference to the fact that a role exists in each of these systems. A coordinator's "total role" can be defined and viewed in the light of the four major systems identified in Figure 1. Role expectations and role definers differ in each of the systems. Figure 2 illustrates one possible mode of conceptualizing the relationship between the building and the operating dimensions following the introduction of the concept of role performance. The building systems are seen as major influences on the operating system.

<u>The perspective of complex organizations versus collective behavior</u>

It should be pointed out that the building system has been discussed in terms of formal or complex organizations by Mulford et al. (1971). The operating system has been discussed primarily in terms of the collective behavior perspective (Dynes and Quarantelli, 1968:416). The building system discussions have focused upon a bureaucratic model or one emphasizing the relationship of lower participants to the organization.

Dynes and Quarantelli (1968:416) point out that most researchers who utilize the collective behavior perspective tend to operate with a model of so-called "unstructured" behavior. "The social phenomena to be examined is viewed as coming into being, relatively amorphous and in general at the opposite pole of bureaucratic or highly institutionalized behavior." The operating system is seen as relatively unstructured. These two perspectives (complex organizations and collective behavior) are not seen as having much in common. Dynes and Quarantelli (1969:416) question this dichotomy and suggest that institutionalized and non-institutionalized behavior may exist together especially in emergency situations. They further point out that the two perspectives should be related or integrated. The illustration in Figure 2 represents an answer or scheme to avoid viewing the operating system as unstructured or uncoordinated. The formulation appears to be useful but differs considerably from the typology employed by Dynes and Quarantelli for the same purpose. This last formulation will be discussed later in a slightly different context.

A theoretical framework

Brouillette and Quarantelli (1969:1) report that sociological theory as it is reflected in the area of complex organizations involves two developmental lines. The first is called the "managerial" developmental line according to Brouillette and Quarantelli (1969) which includes Taylor, Mayo, Chapple, Roethlisberger, Warner, Likert, Bernard, Simon and possibly Etzioni. The common element in these views is the focus upon the "individual worker or work group whose actions, attitudes and motives are to be manipulated in some way for the benefit of managerial and organizational goals" (Brouillette and Quarantelli, 1969:1). Change and adaptation is thought of primarily in terms of individual behavior which represents a social-psychological approach.

The second major line of development in complex organizations (Brouillette and Quarantelli, 1969:2) is concerned primarily with structural characteristics, especially bureaucracy. Weber, Marx, Michels, Merton, Blau, Gouldner and Selznick are reported as being among the theorist representative of this tradition. The complex organization is seen as a "relatively unitary system of collective action." The approach is viewed as "sociological" or structural as in the ideal type of bureaucracy delineated by Weber. Questions are often raised about sociological theory as reflected in both developmental lines, especially in regard to their ability to handle organizational change. Some writers attribute the lack of theory or research on change in complex organizations to these static views which often stress the interdependence of the parts. The emphasis in a study of change, if it were attempted, would tend to be upon disruption in equilibrium and how the organization attempts to maintain or restore equilibrium which is often called adaptation. Adaptations, if they are considered at all, are believed to be short run changes made to adjust to stress situations. The informal system of the organization is often believed to emerge to participate in the development of patterns for problems not provided for by the formal structure. The informal structure, in other words, is believed to replace the formal structure as an adaptative mechanism. The informal structure is envisioned as arising to contribute to effective organizational responses to problems which persist over time.

The emphasis is upon one type of structure being substituted for another and not upon the emergence of new patterns of behavior in response to changed social or physical environments.

Etzioni (1961) implicitly assumes that the compliance system or the relationship of superior to lower participants is in or will tend toward a relatively stable equilibrium. Equilibrium in a "social system" or a "compliance" system may be upset by forces internal or external to the organization. A disaster is an environmental factor outside the organization or subsystem composed of several organizations which may upset the equilibrium and require adjustive activity if the organization or subsystem is to continue its existence.

Inkeles (1964:38) suggested that some theorists such as Parsons have apparently assumed that in an organization "more or less automatic adjustments to redress the balance of its equilibrium" will occur. Others such as Simpson and Gulley (1962) and Katz and Kahn (1966) indicate that the adjustment may not be automatic and corrective measures must be taken to return the organization to equilibrium or insure its survival. Adaptation, in other words, is the process of returning the organization or subsystem to its equilibrium or establishing a new equilibrium level so as to enable the organization or subsystem to cope with the environmental changes.

The problem, however, is how the organization or subsystem is to adapt. What is the process of adaptation? What structures are required? What activities must be engaged in by the organization? What problems must be solved? Simpson and Gulley (1962), Katz and Kahn (1966) and others such as Brouillette and Quarantelli (1969) have addressed themselves to these problems.

Brouillette and Quarantelli (1969:3) claim that comprehensive review of the disaster literature allows the researcher to locate several theoretical discussions but few empirical studies of organizational adaptation to stress. They also report that even the theory is relatively weak due to a lack of consistent use of concepts and a lack of propositions regarding conditions affecting change in the organization. Brouillette and Quarantelli (1969:3) further indicate that there is a need for the development of a "conceptual vocabulary" to study organizational adaptation to stress. The following is a further presentation of some of the literature on organizational adaptation to the environment with a suggestion of some major theoretical issues, concepts and propositions.

Simpson and Gulley (1962) suggest three hypotheses in relation to an organization's adaptation to its environment. The first of these states that the purposes of the organization and the environment impact operating practices as well as internal structures of the organization. The second states that the organizational goals and the environment will influence the behavior of the organization, its participants and its structure. The third indicates that the organization faced with a wide range of pressures will differ in internal characteristics from those with a narrow range of pressures.

Katz and Kahn's (1966) discussion of organizational change suggests a number of interesting points which might be considered in relation to the organization and its adaptation to the environment.

First   Katz and Kahn (1966) suggest that as a result of pressures from the environment, the organizational authority structure, the social relationships and the role structures may change.

Second   Environment, for Katz and Kahn, may be either the physical or social environment and includes technology, cultural elements, legal relationships and climate.

Third   Katz and Kahn suggest that if the environment changes, the organization is confronted with new demands on its resources which must be met in order to maintain old relationships with the environment or else establish new relationships.

Fourth   Katz and Kahn (1966) state that the relationship of the organization to its environment can be summarized by the concept of a "quasi-stationary equilibrium." The organization can handle adequately certain kinds and magnitudes of fluctuations in the environment without organizational system change. The organization merely absorbs and adjusts to the changes and returns to its previous equilibrium level. But if the environmental changes exceed a certain unspecified magnitude, the organization will adjust but undergo systematic change and a new level of equilibrium is established with the environment. (The new level may or may not be permanent.)

Fifth   Katz and Kahn (1966) suggest that a "democratic" organization structure has advantages when: 1) the organization is open to the demands of its environment; 2) the environment is changing and posing complex and difficult problems of adaptation; 3) a value is attached to receiving and using all relevant information; 4) a value is attached to correct response to change in environment rather than speed of response;

and 5) roles require creative effort, broad understanding of organizational functioning, motivation and identification with goals of the organization.

<u>Sixth</u> Katz and Kahn (1966:78) state that environmental pressures which are problems in the objective world requiring coordinated effort of people for the solution and the needs of the population generate new tasks which have to be met by an appropriate structure. The tasks exert pressures on the way the activity will be patterned. "A primitive system emerges in which the basis of productive activities is the cooperative response of people based upon their common needs and expectations." (Katz and Kahn, 1966:78). This structure which emerges often lacks consistent role performance and effective coordination of roles. It is often an informal structure not necessarily in opposition to the formal organization but is characterized by enthusiasm and motivation which must be directed to accomplish organizational goals.

<u>Seventh</u> Survival requirements of a system lead to specialized units or departments concerned with adjustment. These units are often concerned with areas such as: 1) preserving or possibly returning to greater predictability in organizational life and 2) bringing the external world under control and obtaining a constant environment.

The Disaster Research Center (D.R.C.) at Ohio State University has published a number of reports and case studies which suggest how a formal organization and individuals in it might adapt to changes in the physical environment. The following is a presentation of some of the concepts and theoretical issues discussed in the D.R.C. literature. It should be noted that the material in many ways complements and supports the hypotheses presented by Katz and Kahn (1966). A partial listing of the D.R.C. literature is found in the Literature Cited section of this dissertation. Dynes and Quarantelli (1967 and 1968) and Brouillette and Quarantelli (1969) indicate that the informal structures do not replace the formal structure in adaptive responses to stress, but typically there is a "partial emergence of new structures and functions. Four types of adaptation are distinguished and are often presented in terms of a typology of organization based on a cross classification of two dimensions, structure and tasks. Figure 3 illustrates the four organizational types that result from the cross classification of the two dimensions as utilized in much available D.R.C. literature. The D.R.C. typology is quite different from the typology developed at Iowa State University and specified earlier in this chapter.

		Tasks	
		REGULAR	IRREGULAR
Structure	OLD	Type I (Established)	Type II (Extending)
	NEW	Type III (Expanding)	Type IV (Emergent)

Figure 3. D.R.C. typology of organization frequently used in their reports for a wide variety of purposes (Dynes and Quarantelli, 1969:2).

The amount of change required in the D.R.C. typology by the adaptive response to crisis ranges from a slight change in Type I adaptation to great change in Type IV adaptation. Also, organizations follow a sequence in involvement in efforts to adapt. Type I is utilized in the first attempt to adapt, but the demands placed on the regular structure are often so great that a type II or III mode might be more adequate. If the organization fails to adapt using the first three modes, the fourth (Type IV) may be utilized; but this tends to be the last resort. The D.R.C. typology suggests that tasks and structures of organizations change in response to disasters and there is a sequence of involvement of organizations in efforts to adapt. The typology does not as adequately link the normal and stress (disaster) periods as the Iowa State building-operating typology developed earlier in this chapter.

Quarantelli and Dynes (1967) and Haas and Quarantelli (1964) suggest concepts and factors involved in response to disaster. Brouillette and Quarantelli (1969) attempt to present a conceptual model or framework for adaptation to stress, and they suggest factors that might help to account for organizational variation in response. They suggest that it should be possible to predict the type of adaptation through "multivariate and stochastic kinds of studies" which may now be possible in this area. Barton (1969:60) recognizes the need for multivariate research on response to disaster as well as a concern for sampling techniques. Barton (1969), Anderson (1969a and 1969b), Dynes (1969), Dynes and Quarantelli (1968 and 1969) and Haas and Quarantelli (1964) suggest concepts and propositions which might be utilized in such research. A combination of organizational and collective behavior perspectives are suggested. This combination is accomplished in this dissertation through the utilization of building and operating system role performance relationships as developed in the Iowa

State typology presented earlier in this chapter. The utilization of the Iowa State typology allows the researcher to set the goal of making operating system roles as predictable as building system roles.

A Causal Model of Disaster Role Performance

One of the major problems encountered in disaster research is the adequacy of response of organizations and individuals to stress situations and the identification of the factors that are involved. The researchers at the Disaster Research Center as well as others such as Barton (1969) have discussed problems of this type. However, researchers such as Haas and Quarantelli (1964:22) point out that there is "marked variation in the manner in which different organizations respond to the exigencies of a disaster. There is little, either in the literature on disasters or on organizations, that accounts for such variations." The authors, however, do attempt to present an analytical framework comparing organizations under "normal" conditions with those under "stress" situations.

A general statement of the problem area might be in order. The problem is to identify some factors that might contribute to maintenance or restoration of organizational continuity under stress conditions. Much of the literature available will suggest concepts and propositions. However, the problem in this dissertation is building a causal model but not by an axiomatic deductive method. The major goal will be to develop a more adequate theory to explain response to stress situations by identifying relevant concepts and emphasizing relationships between these concepts. The problem involves identification and definition of concepts and utilization of these to explain response to disaster. The present writer is not convinced that the theory in this area is sufficiently advanced to allow the statement of an axiomatic deductive system even though this may be a possibility for future consideration.

A causal model of organizational adaptation to enviromental change will be presented utilizing concepts, propositions and suggestions presented earlier. The model is primarily based on the concepts utilized by the Disaster Research Center in their numerous publications as well as the work of Allen Barton (1969). It should be realized that the model as presented in this paper does not appear in any of the works cited above but is the present writer's attempt to summarize and draw together for the first time relationships noted in numerous case studies.

<u>The concepts in the model</u>

In the model, operating system role performance will become the dependent variable. The other concepts or "units" (Dubin, 1969) of the theory will be nominally defined. As each concept is introduced in the following section, suggested relationships between concepts will be presented. Figures 4-12 are illustrations of the hypothesized relationships between the concepts. In each figure, a straight unidirectional arrow indicates assymetric causation and the direction of the relationship. A plus or a minus on the arrow indicates whether the relationship is expected to be positive or negative. A curved double-headed arrow indicates association or correlation but not causation. Formal statement outside the text of the two variable hypotheses will not be presented as they are illustrated in Figures 4-12 and in the equations as developed in Chapter 3. The definition of the concepts are presented below. It should be pointed out that agreement on definitions of these concepts has not emerged and definitions should be regarded as tentative at best.

Building system role performance (X_1) Building system role performance refers to the role performance in the organization prior to the disaster. Role performance is defined (Mulford et al., 1971) as the actual behavior of the coordinator that is judged relevant to his job in the building system. There has been a relatively large amount of research on role performance in the building system such as Mulford et al. (1970) and Mulford et al. (1971). Both studies mentioned above are empirical tests of the Etzioni (1961) model of normative organizations. The variables utilized by Mulford et al. (1971) to predict role performance include socialization, communication, scope, pervasiveness, salience, tension and selectivity.

Haas and Quarantelli (1964:2-3) distinguish between organizations under "normal" and "stress" conditions. It would appear that the distinction is somewhat similar to that between building and operating systems developed earlier in this chapter. Building system role performance is performance in the building system under "normal" conditions where the organization is viewed by Haas and Quarantelli (1964:2) as a relatively permanent, complex interaction system. Haas and Quarantelli (1964) report that the roles under "normal" conditions are discernible and "normal" conditions constitute a steady state or equilibrium which may be disrupted by a disaster agent of some type.

Disaster (X_2) Disaster is a concept which has many meanings (Dynes, 1969:61) often depending on the researcher who utilizes the concept. A disaster, however, has several characteristics which are listed to help obtain a definition. The following characteristics are adapted from a publication of the Disaster Research Center (Dynes, 1969) and from the Quarantelli and Dynes editor's introduction to the special issue of American Behavioral Scientist (1970) devoted to response to disaster as well as from Drabek (1970).

1. The disaster agent is an important characteristic. The agent might be a fire, earthquake, tornado, blizzard or bomb. However, it should be pointed out that in this dissertation, the researcher assumes that regardless of the disaster agent, there will be similarity of response and the same set of concepts may be utilized to explain variations in response.

2. The physical impact of the disaster agent is a second characteristic with important ramifications for adaptation of the organization. The disaster agent may bring a) damage to property, b) loss of life, c) psychological impacts and d) disruption in organizational and community life.

3. A third important characteristic is the evaluation of the seriousness of the impact by different individuals and groups. A disaster is evaluated as to its severity, impact, area and so on.

The disaster may have other important elements such as suddenness, unfamiliarity and localized impact. Disaster is tentatively defined as the impact of a disaster agent involving evaluations of seriousness of impact which may result in unfamiliar expectations for individuals and organizations in a community.

Prior warning (X_3) Prior warning refers to the length of time warning was received prior to the arrival of the disaster agent. Some disasters are preceded by warning but others are preceded by little or no warning. It is assumed that organizations which receive warning are provided with a period of time in which to prepare for the events which follow and will be somewhat different from those with little or no warning.

Social disorganization (X_7) Social disorganization refers to the disorganizing effect on aspects of social life as a result of the disaster agent. Three elements are involved.

Uncertainty (X_4) The first is uncertainty which refers to the fact that organizations and individuals before a disaster have a routine which has become the accepted pattern of activity. The disaster disrupts the routine by requiring the accomplishment of new non-routine tasks. Motivation to perform the tasks is assumed to exist, but the individual may not be certain of what is expected of him. There may be uncertainty about 1) the nature of the demands on the organization and the individual, 2) the status or availability of other personnel, 3) the availability of resources to accomplish the task and 4) the status of other organizations such as the Salvation Army, police department, public works or the fire department. Uncertainty refers to the degree of awareness in regard to the pattern of activity needed to recover from the disruption of a disaster.

William A. Anderson (1969a:5) in a study of civil defense in disaster points out that organizations such as civil defense have a latent disaster role (role becomes explicit only under emergency conditions) and are often characterized by a greater degree of uncertainty than organizations with explicit disaster roles such as police or fire departments. However, in order to remain viable following the disaster, some means must be developed to cope with the uncertainty or reduce the instability that follows the disaster. Anderson (1969a:6) states:

> Disasters present new sources of uncertainty for groups and organizations. Yet, much of the instability in group and organizational functioning during disaster can be viewed as

> having pre-disaster antecedents. As stated previously, it is our thesis that pre-disaster uncertainty is the basis of many of the dilemmas which confront civil defense organizations during disaster. We further suggest that the internal processes as well as the extra-organizational relations of civil defense organizations during disaster will reflect such uncertainty.

The argument by Anderson (1969a) implies that the severity of the disaster is causally related to uncertainty. The more severe the disaster, the more uncertain the response by organizations with latent disaster roles.

A second implication is that the pre-disaster or building-system role performance is causally related to the level of uncertainty since preparations are almost never complete enough to allow the coordinator to be completely certain of expectations. In other words, pre-disaster uncertainties are heightened following the disaster. It appears reasonable to assume that the higher the building system role performance, the higher the uncertainty.

A third implication is that the length of warning is causally related to the level of uncertainty. The longer the warning period, the less uncertain the reaction. More warning before the onset of the disaster may allow time for final preparations to become more familiar with the capacities of organizations and individuals.

Figure 4 is an illustration of the hypothesized relationship between a number of concepts and uncertainty.

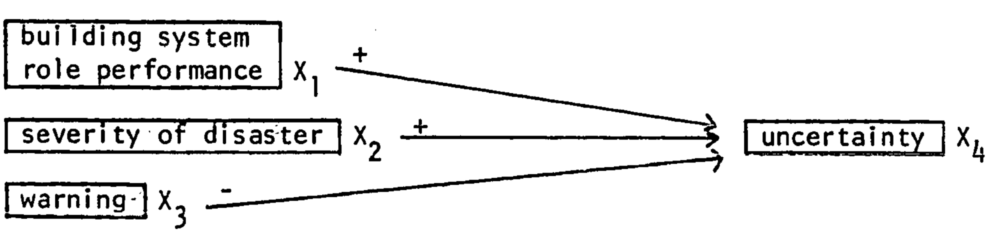

Figure 4. The variables hypothesized to causally affect the level of uncertainty.

Role conflict (X_5) The second element in social disorganization is role conflict which refers to the inconsistent or conflicting role expectations perceived by the individual as a result of multiple group memberships. According to Killian (1952), the individual may be confronted with expectations from several social systems, among these are the family, the community and the organization. Killian (1952:310) suggests that during normal situations, a man may "function efficiently" as a member of differing groups of social systems without becoming aware of the inconsistencies or contradictions. However, when disaster strikes, many may find that these latent conflicts suddenly become pressing and a decision is required.

Killian (1952) further suggests that how these conflicts are resolved will be extremely important for the organization in terms of the role that may be played following the disaster. Killian implies that the severity of the disaster in terms of its perceived impact on family and friends versus the community or organization may be a relevant factor. If, for example, the individual knows his family is safe, he may feel more free to play an organizational role. On the other hand, it is suggested by Killian (1952:314) that "training or feelings of responsibility, may predispose the individual to adhere to secondary group demands even in a disaster." Two causal relationships are suggested by Killian. The first is the more severe the disaster, the greater the role conflict. The second is the higher the building role performance, the greater the role conflict. It is believed that stress and uncertainty are each associated or correlated with role conflict. No explicit or implicit theoretical statement was located to suggest causal relationships to be specified. It is not clear, for example, whether stress causes role conflict or if role conflict causes stress.

Figure 5 is an illustration of the hypothesized causal and associational relationships between the concepts and role conflict based on the arguments presented above.

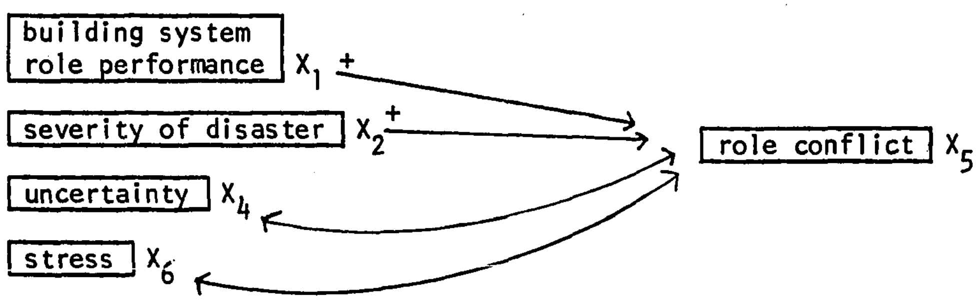

Figure 5. The variables hypothesized to causally affect the level of role conflict

Stress (X_6) The third element of social disorganization is stress which refers to the perceived demands placed on the organization as well as the individual in terms of time and resources. An increase in tasks, which would previously be dealt with in a routine manner or delayed, suddenly become pressing and demands immediate attention (Haas and Quarantelli, 1964:5). Also, a situation in which lives or property is destroyed could be viewed as stress producing for individuals in the organization. Stress, according to Barton (1969:38) occurs when "many members of a social system fail to receive expected conditions of life from the system." These expected conditions might be safety, protection from attack, food, clothing, shelter, guidance or information needed to carry on daily activities. Haas and Quarantelli (1964:5) imply that stress occurs when there is a change in the demands on the organization with or without change in the capacity of an organization to respond to these demands. Brouillette (1970:375) states, "Sometimes disaster agents cause sufficiently severe disruption to community functioning that organizations responsible for coping with the emergency cannot meet the demands with their normal structure and standard operating procedures."

Theoretical arguments suggest that the more severe the disaster, the greater the stress. Figure 6 is an illustration of the suggested causal relationship. It should be pointed out that it is believed that the degree of role conflict is associated with stress, but no theoretical arguments were found in the literature to suggest a causal linkage.

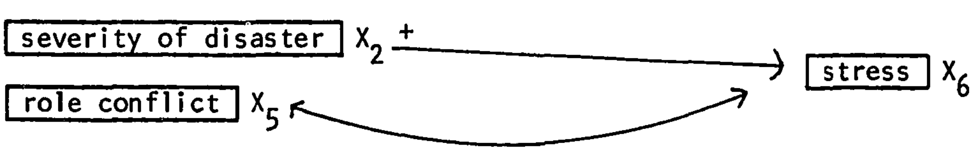

Figure 6. The variables hypothesized to causally affect the level of stress

It should be pointed out that the present writer assumes that there is an association between role conflict, uncertainty and stress, but no adequate theoretical statement was located that would suggest causal relationships to be hypothesized. Therefore, the relationships are diagrammed with a curved arrow to indicate correlation, but no causal relationships are identified. These concepts may, however, be grouped together as social disorganization. In other words, social disorganization is believed to be composed of three elements--uncertainty, role conflict and stress. No distinction in terms of levels of abstraction is implied by this grouping.

Organizational autonomy (X_8) The eighth major concept is organizational autonomy which refers to the degree to which an organization is able to control its own activity or environment. It is expected that organizations will persist in efforts to control their own activity and environment in ways which were utilized before the disaster. In other words, it is expected that the organization and individuals will attempt to maintain as long as possible procedures, practices and independence of operation even though the environmental conditions have been altered. A "normal" mode of operation, however, may not be maintained and organizational autonomy may need to decrease if recovery activity is to proceed, and the organization may become less able to control its own activity and may have to seek legitimation from others and is in fact dependent on the activities of others.

Brouillette and Quarantelli (1969) in their discussions of organizational adaptation to stress indicate that the organization, faced with increased demands as a result of the disaster, will tend to undergo changes in tasks and structure. However, the initial tendency is to persist with the old structure and tasks utilized before the disaster. A "de-bureaucratization" (loss of autonomy) occurs where the organization modifies its structure and its tasks resulting in less autonomy. The typology presented earlier in this chapter and frequently associated with the D.R.C. researchers was utilized to illustrate the de-bureaucratization process or loss of autonomy with a public works department. The determinants of autonomy are not clearly specified in the literature. As Brouillette and Quarantelli (1969:3) point out: "Even the theoretical literature is weak because of its inconsistent use of terms and its lack of propositions which may affect change." Brouillette and Quarantelli (1969) also comment on the need to develop a "conceptual vocabulary for the purpose of studying organizational stress." The comment appears relevant here.

As a result of the inconsistent use of terms, the lack of a strong theoretical argument and the lack of propositions, the present writer will suggest some hopefully plausible determinants for organizational autonomy based on a reading of the literature. It is suggested that a high degree of uncertainty will lead to heightened organizational autonomy. Also, it is suggested that a high level of stress will lead to heightened organizational autonomy. It is suggested that high uncertainty and high stress will each tend to cause a coordinator to attempt early in the recovery period to maintain independence of action and control over organizational activity independent of others.

Figure 7 is an illustration of the concepts which are believed to be related to organizational autonomy.

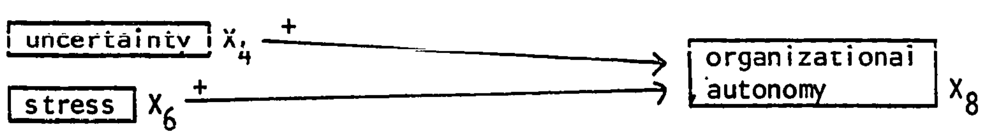

Figure 7. The variables hypothesized to be causally related to the level of organizational autonomy

Need for information (X_9) The ninth major concept is the need for information which refers to the perceived need for data in the following areas: the disaster impact, the disaster agent, the evaluation of the event by others, the demands to be made on the individual or organization, the availability of resources, the status of other organizations and the safety of relatives.

Dynes (1969:87) reports that initial evaluation may be a difficult task considering the conditions imposed by the impact of the disaster. It was noted by Dynes (1969) that there may be no existing organization within the community to collect and evaluate data on the scope of impact and location of impact especially if the disaster struck with little or no warning. Dynes (1969:87) states:

> Initially, no one individual has a very accurate view of the event. Those who are immediately involved can only perceive what immediately surrounds him. In this, some initial disorientation occurs since many of the characteristics which originally made the situation familiar have disappeared.

The determinants of need for information are not clearly specified in the available literature. However, it appears that the extent of warning before the disaster may be causally related to the extent of information that may be needed. The greater the warning time available, the greater the amount of information that can be gathered on possible impact. The mechanism for obtaining information can be set up if the warning period allows. Furthermore, it would appear that need for information may be related to role conflict. Information may be needed to resolve role conflicts. For example, if the individual is concerned about the safety of his family following the disaster, he may need information to resolve conflicts so that he may continue or begin to work in recovery related activities. The greater the role conflict, the greater the need for information. Based on the literature on disasters, it appears that stress is causally related to the need for information, hence, the greater the level of stress, the greater the need for information. The information would appear to be needed in order to adequately cope with the increased stress or demands on the organization.

Figure 8 is an illustration of the concepts believed to be related to the need for information.

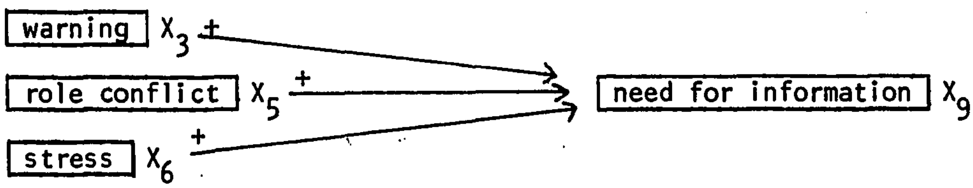

Figure 8. The variables hypothesized to be causally related to the level of need for information

Communication (X_{10}) Communication is the tenth major concept. Communication is a process with four elements (sender, message, channel and receiver). Communication has two sub-processes. The first is encoding which refers to the process whereby the meaning of the message is presented as a series of symbols. The second is decoding whereby symbols conveyed by the channel are assigned meaning by the receiver. The meaning of the message resides in both the sender and the receiver. The communication is complete when there is reception by the receiver. Communication is a means of conveying messages from sender through a channel to a receiver.

Following a disaster, communication is necessarily high in order to provide information for policy decision, for knowledge of the extent of the disaster, the number of victims, property damage, safety of relatives and so on. Also, it is often necessary to have a communications center (Stallings, 1971:14) where messages from the numerous senders can be directed to the appropriate receivers in order to provide effective responses to the disaster. This center is sometimes provided through pre-disaster planning, but it may emerge in response to the disaster demands provided some equipment has been secured earlier.

Stallings (1971:4) reports that prior to the disaster, there is an equilibrium in which the demands and the capacities of an organization are in balance. However, once this balance is disturbed, an adjustment must be made. He states: "Should this hypothetical balance be disturbed as in large scale emergencies, it is proposed that adjustments will take place to create a new balance between demands and capacities." He further state states that changes will occur in "the way in which members relate to one another while performing their separate tasks." The argument made by Stallings (1971) implies that a high degree of stress will cause a high level of communication. In other words, the higher the level of stress, the higher the level of communication. Communication is an activity engaged in to help to "adapt" to the changed circumstances surrounding the onset of the disaster. The argument by Stallings (1971:44) further suggests that the degree of organizational autonomy impacts the level of communication. The greater the extent to which the organization is able to maintain its autonomy, the less the communication between organizations required to accomplish necessary tasks.

A third statement by Stallings (1971:45) is suggestive. He states: "Problems of communication in disaster seem to spring most often from the use of means of message exchange which are new and unfamiliar to the members of a particular group in question." He points out that organizations, such as Civil Defense, which have their "normal" or building system activities concentrated in one or more locations but whose disaster activities are associated with dispersal of units to scattered locations are particularly faced with this communications problem. This last argument suggests that the degree of uncertainty impacts the level of communication as well as the adequacy of communication. The argument suggests that the higher the level of uncertainty, the higher the level of communication.

Figure 9 is an illustration of the concepts believed to be causally related to communication.

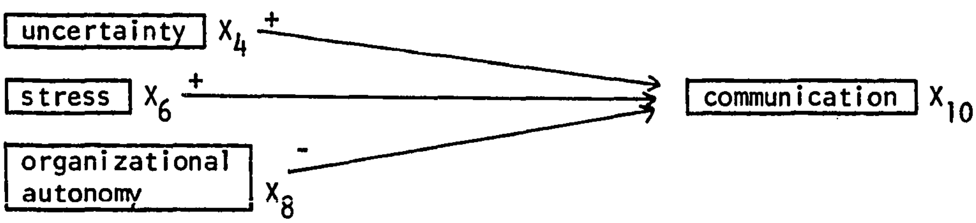

Figure 9. The variables hypothesized to be causally related to the level of communication

<u>Rank</u> ($\underline{X}_{11}$) The eleventh concept is the rank of the operational personnel in the organization. Rank refers to the perceived status of operational personnel. It is expected that the rank of operational personnel in recovery operations will be perceived to increase during recovery operations especially if they directly engage in the recovery related activities. The rank is expected to increase if they are placed in the center of a communications network and are able to provide others with needed information, resources or services. Quarantelli and Dynes (1967:7) suggest that an increase in rank may occur in the operating system. They suggest some factors that might account for the increase in rank. They state that: "groups with a specific coordinating function such as civil government or civil defense may be almost ignored prior to the disaster

but become exceedingly important during a disaster." Also, Anderson (1969a:41) states:

> Civil defense organizations have pre-disaster knowledge concerning the location of disaster-relevant resources and capacities in their respective communities and areas...obviously, prior knowledge of available emergency resources in the form of inventories would enable civil defense organizations to more rapidly procure assistance for those in need, whether it is the general public or units of the synthetic organization.

These statements imply that the building system role performance of the civil defense director will influence his rank in the operating system. The higher the building system role performance, the higher the rank in the operating system.

Anderson (1969a:30-32) suggests that the authority structure of a civil defense organization is quite different following a disaster from the period before the disaster. Some of these changes are planned but others emerge spontaneously. Civil defense, according to Anderson (1969a), tends to expand in that volunteers are incorporated into its structure. Civil defense may assume more authority in relation to other organizations and government departments. As a result, according to Anderson (1969a:32), civil defense may "tend to experience a task overload during a disaster. Yet it is a time that tasks and decisions must be promptly carried out..." The implication is that the level of stress on the organization may influence the rank of the coordinator. The greater the stress, the higher the rank in the operating system.

Anderson (1969a) also states that the relaying of information is an important task for the local coordinator following a disaster. The implication of his argument is that if civil defense has the equipment and engages in communication, the coordinator will emerge as the central link in a larger communications network. Thus, the coordinator's rank is seen to increase as a result of the increased communications activity he engages in relative to the needs of others. Also, Anderson implies that the rank of the coordinator is dependent upon the degree to which norms arise in the recovery or operational system which alters the previously existing status arrangements to allow for this increase in status for the coordinator. The greater the degree of emergence of norms of cooperation, the higher the operating system rank of the coordinator.

The following diagram in Figure 10 will show the hypothesized causal relationships for rank.

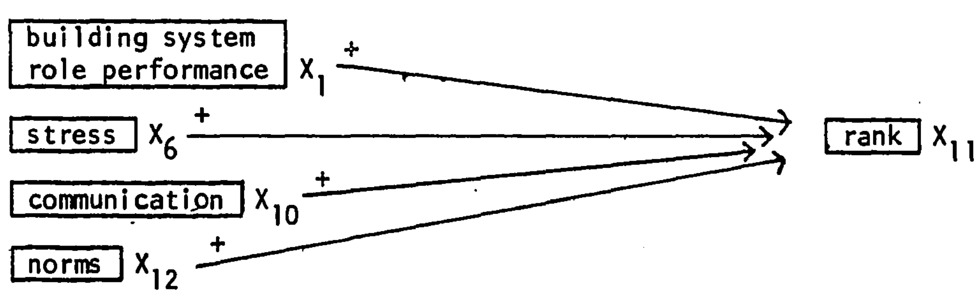

Figure 10. The variables hypothesized to be causally related to the level of rank in the operating system

Norms (X_{12}) Another major concept is norm which refers to written and unwritten rules prescribing acceptable and unacceptable behavior. Norms are standards which influence the choice of goals and govern the selection of the means to reach these goals. The norms which exist before the disaster may no longer be appropriate following a disaster. New norms often emerge during recovery which may facilitate recovery or adaptation. The emergent norms are often not written but they prescribe acceptable and unacceptable behavior. Status distinctions may be ignored, new dress standards become acceptable, new channels of communication become appropriate, an emphasis on help for others emerges, a new authority structure and relationships may emerge to fill an authority gap and "emergency consensus" (Quarantelli and Dynes, 1967:3 and 1970:7) or a "therapeutic community" (Barton, 1969) emerges.

The emergence of norms in the operating system appears to be causally related to a number of factors. The first of these is the severity of the disaster. The typology created by the Disaster Research Center presented earlier in this chapter is suggestive. One implication of the sequence of involvement of organizational types is that the more severe the disaster, the more likely a Type III or Type IV organization will emerge. Also, it is suggested that the degree of stress is causally related to the emergence of norms. This relationship was suggested by Dynes and Quarantelli (1968:2) in that the sequence of involvement appears to be related to accomplishment of the many non-routine pressing tasks that result from the disaster.

Anderson (1970:421) presents a case study of the military in natural disaster in which the response to disaster and emergence of norms was discussed. These discussions imply that need for information, communication and stress lead to the emergence of norms. Further evidence for the relationship between need for information, communication and norms is suggested in a quote from a monograph prepared for the Office of Civil Defense by the Disaster Research Center. Dynes (1969:87-88) states that:

> There are some indications that many traditional barriers to interaction which existed prior to the event are lowered. In other words, everyone can communicate with others on the basis

> of the common experience which now binds them together...Much of this sharing, however, is the communication of the individual's experience and his definition of what happened.

It was difficult for the present writer to locate more precise specification for these relationships, but these suggested by Anderson (1969a and 1970) and Dynes (1967 and 1969) appear reasonable. The more severe the disaster, the greater the emergence of norms of cooperation. The greater the stress, the greater the emergence of norms of cooperation. The greater the level of communication, the greater the emergence of norms of cooperation.

Two relationships, which are not clearly delineated in the literature, will be specified in this dissertation. The first is the relationship between role conflict and norms. It is believed that norms of cooperation emerge as a partial solution to role conflict. Therefore, the greater the role conflict, the greater the emergence of norms of cooperation. The second relationship is that between need for information and norms. It is believed that norms of cooperation emerge as a partial solution to information gathering activity following a disaster. Norms, in other words, may emerge out of attempts to obtain information and partially provide the needed data. Therefore, the greater the need for information, the greater the emergence of norms of cooperation.

Figure 11 is an illustration of the concepts believed to be related to the emergence of norms following a disaster.

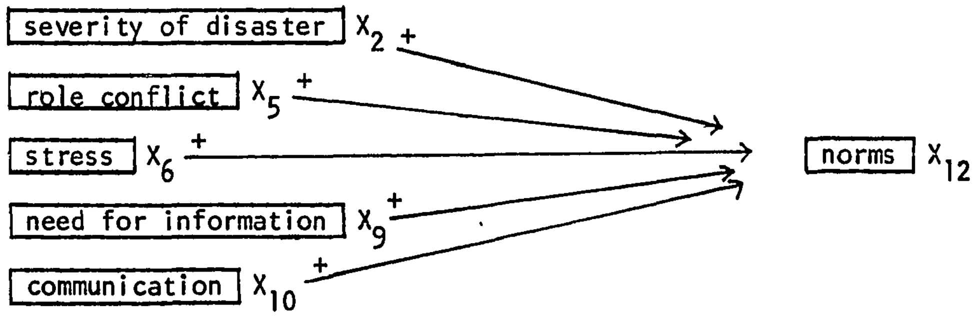

Figure 11. The variables hypothesized to causally effect the emergence of norms following disaster

<u>Operating system role performance</u> ($\underline{X}_{13}$) Operating system role performance is the thirteenth major concept and refers to the behavior of the operational personnel in the recovery period. According to Anderson (1969a), the role of civil defense coordinators in recovery involves providing: 1) technical advice to community decision makers; 2) organizing volunteers; 3) coordination of organizations such as the Salvation Army, Red Cross, police department and fire departments that become operational following the disaster and 4) procurement of equipment and supplies as civil defense is an expanding organization in recovery operations. Civil defense may also engage in a number of other activities.

Mulford et al. (1970) and Thompson (1967) defined coordination as a process where organizations become articulated so that interaction among organizations is thought better than no interaction. Organizations become dependent on each other for the attainment of organizational goals. Three types of coordination were presented and these were: 1) coordination by standardization, 2) coordination by plan and 3) coordination by mutual adjustment. The first type of coordination is called vertical coordination (Mulford et al., 1970) or coordination by standardization

(Lindblom, 1965 and Thompson, 1967). In this form, coordination is obtained through the establishment of formal rules that are often written and tend to become standardized over time. The model of coordination by standardization is the bureaucracy.

The second form of coordination is coordination by plan. In this form of coordination, the coordinator is not assumed to be situated in a hierarchy. There may be some legal lines of authority and even sanctions to obtain action designed to achieve organizational objectives. However, in this form of coordination, the units are brought together or integrated through the use of a plan.

The third type of coordination is called mutual adjustment or horizontal coordination. Mutual adjustment coordination refers to the situation in which no legal or formal lines of authority exist to encourage or direct action to accomplish organizational objectives. A hierarchy is not assumed to exist. Coordination or integration is achieved horizontally or between equals. Persuasion or negotiation is utilized rather than other forms of power to obtain the objectives of the organization.

It is expected that civil defense and other organizations will attempt to plan for disasters before they occur, but action in disasters will rarely occur exactly as planned. Also, it is expected that organizations will attempt to adapt to change in their environment by maintaining old structures and tasks (organizational autonomy) which means that each separate community organization will attempt to coordinate activities within its own sphere of activity by coordination by standardization. If the demands become too great to be coped with in this manner, coordination by mutual adjustment will be utilized. In this last situation, a new authority structure will emerge to coordinate the activities of recovery operations. A hierarchical arrangement is no longer assumed to exist among organizational leaders, no clear lines of authority and no formal sanctions to enforce conformity to norms exist. The coordinator engages in negotiation and persuasion, but he does not command.

The coordinator role emerges in the attempt to adapt, and the role may be played by the mayor, the civil defense director, the police chief or some other local official. Or, a coordinative body may emerge which serves for the whole community. If the civil defense director does not become a coordinator, he may play the role of advisor. However, the coordinator role often emerges and the coordinator becomes a key link between organizations to accomplish goals. The literature available such as Yutzy (1970) suggests that a system of goals or priorities emerge in disasters. Coordination is the means used to obtain these goals. The following is a list of these priorities: 1) preserve human life, 2) maintain or restore essential services, 3) maintenance of the morale of the public, 4) maintenance or restoration of order and 5) provision of support for individuals and families. Stallings (1971:4) suggests several propositions in his statement:

> Since we view communication as a process vital to coordination, we expect that organizations responding to a community crisis will assign high priority to maintaining their communication processes during disaster. We assume that organizational functioning would be difficult, if not impossible, without at least internal communication and certain kinds of inter-organizational communication as well...

The implication is that communication is causally related to operating (coordinating) system role performance. A further implication is that the higher the level of communication, the higher the level of role performance in the operating system. Stallings (1971:46) states: "the kinds of changes introduced to maintain or expand the level of communication in disaster are most likely to be in the direction of increasing organizational capacity."

It was reported earlier in this chapter of the dissertation that civil defense had a role in disaster that included the acceptance of a number of activities as well as the possible coordination of disaster activities. Generally, if the coordinator is to assume this role, it requires an increase in rank during the operating system compared to his rank before the disaster. During the building system, the role of the civil defense coordinator is less extensive and relatively low in rank compared to other departments in local government. If this argument is accepted, it may be inferred that rank in the operating system is causally related to role performance. Furthermore, the higher the rank of the local coordinator, the higher the level of operating system role performance of the coordinator. One further implication is that building roles are related to operating roles. The higher the building system role performance, the higher the operating system role performance.

Anderson (1969b:11-12) reports that the structure of an organization reflects the degree to which the organization and its functions are valued by the community at large. Preparation for disaster is a function of civil defense. This function is often held in low esteem compared to the functions of police and fire departments. One consequence is that civil defense often must depend upon volunteers to carry out its function both in the operating and building systems. These volunteers are often not certain of rules, procedures and activities of the organization. The implication is that the building system role performance is causally related to both the degree of certainty and to operating system role performance. The argument also implies that the lower the uncertainty the higher the role performance. The higher the building system role performance, the lower the level of uncertainty.

An argument that might be made in regard to role performance in the operating system is that it is inversely related to stress. This argument was not specifically referred to in the disaster literature. However, if stress is extremely high, it might "cause" individuals to play their roles poorly in disaster. It is suggested here that the lower the level of perceived stress, the higher the level of role performance in the operating system.

Anderson (1969a:8-16) implies that civil defense is an expanding organization utilizing volunteers and has a coordinating function. Dynes (1970 and 1969) also suggests that civil defense is an expanding organization with a major coordinating role in disaster. One implication is that to the degree that civil defense maintains its autonomy and routines as established in the building system; it will have a low role performance in the operating system. Conversely, the lower the organizational autonomy, the higher its role performance level.

Two additional relationships will be suggested that do not appear in the literature. The first is a relationship between need for information and operating system role performance. The civil defense coordinator is believed to need data in order to perform his role and provide information to others in the community following the disaster. The higher the need for information following the disaster, the higher the operating system role performance. The second is a relationship between the emergence of norms of cooperation and operating system role performance. The emergence of cooperative norms in the operating system would appear to facilitate the performance of disaster related roles by defining the appropriate type of behavior. It is suggested that the higher the emergence of norms of cooperation, the higher the operating system role performance.

The concepts that are hypothesized as being causally related to operating system role performance are diagrammed in Figure 12.

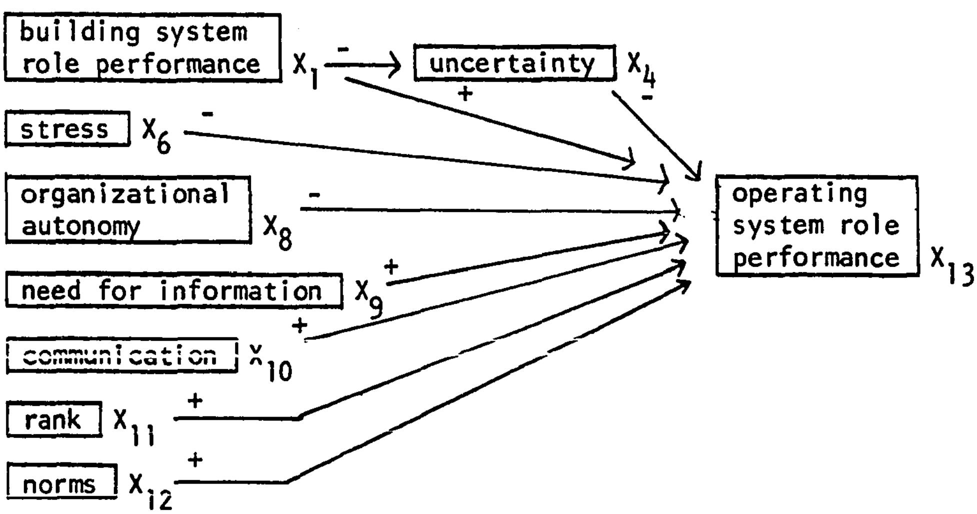

Figure 12. Variables hypothesized to be causally related to operating system role performance

Alternative causal models of role performance in the operating system

A completed causal model of role performance is illustrated in Figure 13. As each concept was defined, its relationship to some of the others was suggested. Figure 13 includes all relationships specified in this chapter. This model is to be known as Model I.

An alternative model (Model II) is diagrammed in Figure 14. The primary difference between Model I and Model II is that Model II has fewer variables and is simpler than Model I. The reason for creating Model II is that the variable social disorganization is believed to be composed of three elements--role conflict, uncertainty and stress. The three variables are combined into one variable and this reduction in number is the reason for the increased simplicity of Model II. Also, as noted, the literature related to disasters suggested little in terms of how these variables (stress, role conflict, uncertainty) relate to each other. However, it is often suggested that disasters are a disorganizing influence as a result of these three factors, and it appears fruitful to utilize a concept suggestive of social disorganization. Model II shown in Figure 14 includes this variable.

The propositions

During the preceding discussions, a number of hypotheses were suggested. Each of these could be explicated in verbal form resulting in fifty-six ordinary language two-variable hypotheses with thirty-three for Model I and twenty-three for Model II. However, it should be pointed out that each of these relationships is a part of a system or network of relationships. Little appears to be served by a listing of all relationships that specify only two of the variables at a time which are involved in a much larger network. Figures 4-12 illustrate the development of hypotheses within the models. Figures 13 and 14 represent the total models with all relationships specified. No attempt will be made at this time to

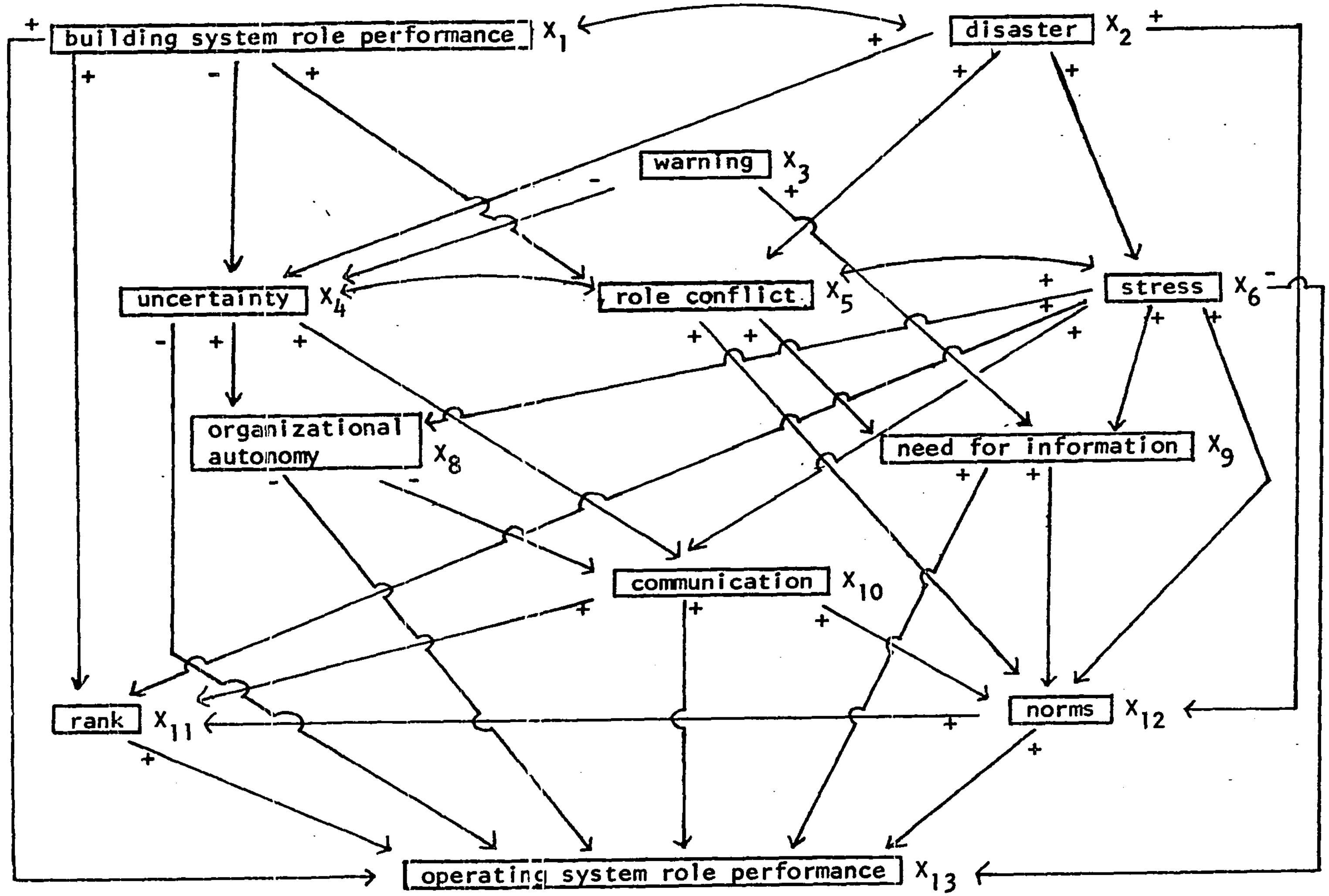

Figure 13. Causal diagram of variables hypothesized to affect the level of operating system role performance of local coordinators (Model I)

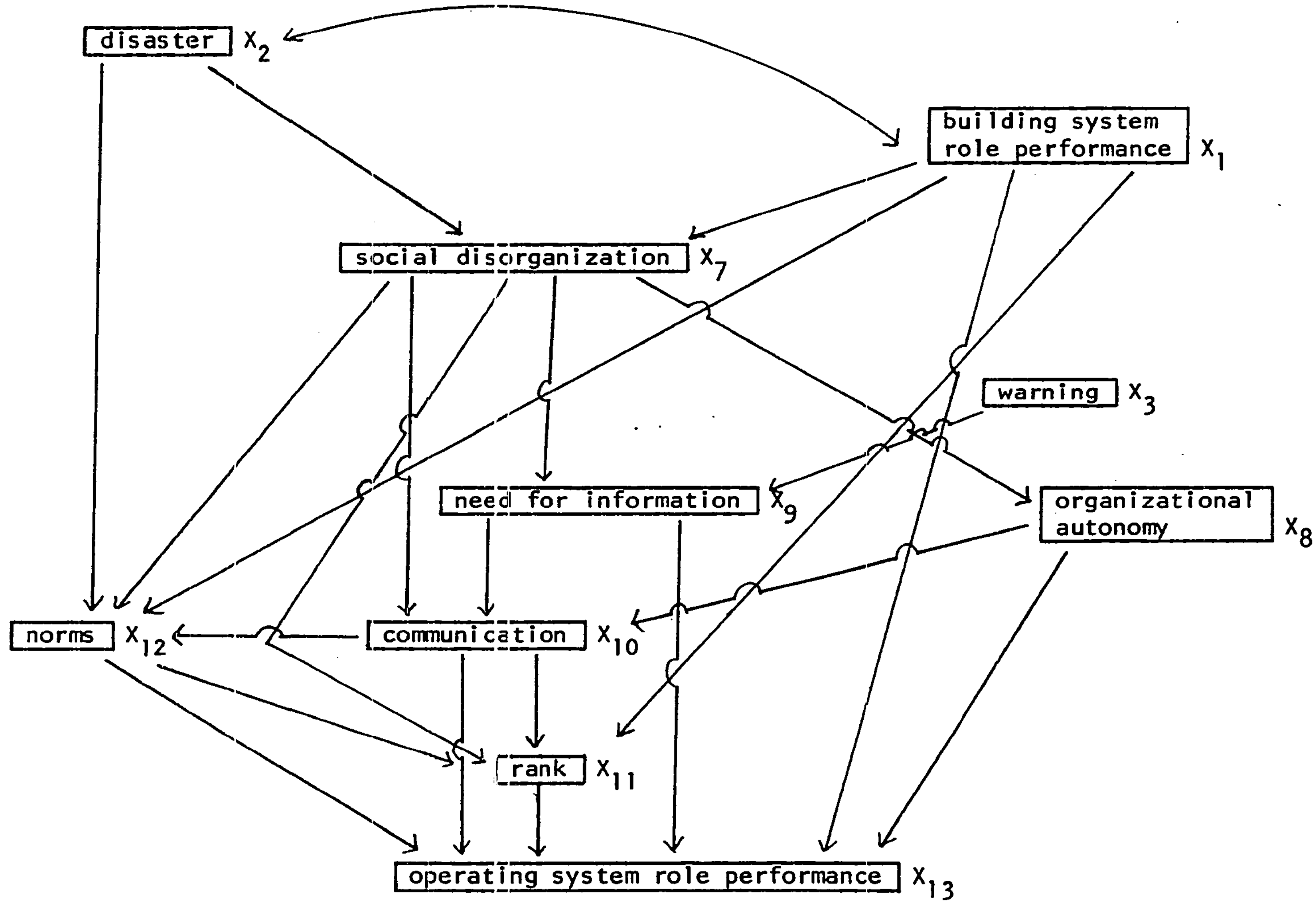

Figure 14. Causal diagram of variables hypothesized to affect the level of operating system role performance of local coordinators (Model II)

utilize these propositions in an axiomatic deductive framework or verbally list them. Figures 13 and 14 represent the hypotheses to be tested.

CHAPTER 3. RESEARCH METHODS

Introduction

The theoretical model developed in the previous chapter was designed to be general enough to be applicable to a number of differing situations. In the present chapter, the concepts included in the model are operationalized at the empirical level. The following chapter will be used to describe the empirical setting of the civil defense agency following a disaster. The objectives of the present chapter include: 1) a discussion of the data collection procedures including the population and samples, 2) the operationalization of the concepts introduced in the previous chapter, 3) the development of empirical measures or scales suitable for testing the hypothesized causal relationships specified in the causal model and 4) a presentation of the statistical procedures to be employed in the dissertation.

The Empirical Setting

The data collected in this study represent a portion of the data collected during the summer of 1971 under a contract between Iowa State University and the Office of Civil Defense.[1] One of the major objectives of the study was to specify the role of the civil defense coordinator in the operating system. A portion of this effort involved collection of data on

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[1]The research was conducted under the direction of project co-directors, Gerald E. Klonglan and Charles L. Mulford. Charles T. Griffin, research associate, served as task area coordinator on the project. The project was conceptualized and conducted from March 1, 1971 through May, 1972. The research was funded by the Office of Civil Defense through Contract No. DAHC-20-71-C-0272, Work Unit 4421D. The Iowa State University Agriculture and Home Economics Experiment Station Project Number was 1754.

the coordinators who had experienced a disaster in their jurisdiction. The report by Mulford et al. (1972) may be consulted for a more complete description of the research of which this dissertation is a part.

These data were collected through a combination of telephone interviews and personal interviews. A telephone screening interview schedule was developed to screen those local civil defense coordinators who assumed operational roles following a disaster from those who have not assumed operational roles. The telephone screening schedule was utilized to determine whether additional data was needed from the local operational coordinators. The additional data was obtained through the use of the personal interviews which were set up at the time of the telephone interviews. The interviews were held in four states--Iowa, Illinois, South Dakota and Minnesota. The report by Mulford et al. (1972) should be consulted for a more complete description of the empirical setting for the research as well as the sampling techniques employed.

The sample area was chosen for the following reasons:

1. The sample area contained a variety of types of disasters even though some types of disasters such as earthquakes and hurricanes were not included.

2. The sample area was located near enough to Iowa State University so that expense could be kept at a minimum yet reach a rather large number of CD areas which had been officially declared as disaster areas.

The population studied

The respondents chosen through the use of the screening device were not meant to be representative of all civil defense coordinators. The researchers assume that they had a purposive sample and located all those coordinators in the sample who assumed an operational role in the sample area following a disaster through the use of the screening device. The data collected is essentially from a purposive sample of the population of coordinators who assumed an operational role following an officially declared disaster in Iowa, Illinois, South Dakota and a portion of Minnesota. The coordinators in other areas of the country, however, might be quite different, so no generalization can be made to other coordinators.

The population chosen for study consisted of civil defense coordinators in counties which had been officially declared as disaster areas by O.E.P. from January 1, 1967 until January 1, 1971. The areas that were in the population include Iowa, Illinois, South Dakota and the southern three tiers of counties in Minnesota. Prior to the telephone interviews and personal interviews, each regional civil defense director and each state director was informed by phone and by letter that Iowa State University personnel would be in their area, and permission was obtained from each before any work was begun.

It should be emphasized that time and cost factors limited the number of interviews, size of the sample area as well as the variety of disasters which were included. Obviously, since the sample area is located in the Midwest, some types of disasters were not included such as earthquakes and hurricanes.

Interview schedule design and pretest

A pretest was conducted in July, 1971. Five civil defense directors were selected for the pretest. All were county directors and two had been recommended by the state director of civil defense in Iowa but were on the O.E.P. disaster declaration list. It was necessary to revise the form and content of some of the questions to correct difficulties which were encountered in the pretest situation. These five coordinators were added to the fifty-four that were interviewed in August which gives a total of fifty-nine coordinators from which interview data was collected.

The interview schedule was partially designed to reflect current OCD concerns relative to natural disaster operations. Role performance items as well as items designed to measure the other concepts were developed and included in the interview schedule to be utilized in building the causal model developed in this dissertation.

The sample and field procedures

It should be emphasized that the O.E.P. list and the phone screening schedule were utilized to locate civil defense coordinators in the sampling area who had experienced a disaster (not necessarily the one O.E.P. specified), had been the coordinator at the time of the disaster, knew about the disaster and operations in the disaster and had assumed an operational role in some capacity (as determined by a series of items about recovery related activities utilized in the screening device). However, some data was obtained from 128 coordinators in all counties which had been declared disaster areas even though intensive interviews were conducted with those who had operated more extensively. The research reported in this dissertation is based only on the personal interview responses of the operational coordinators.

A list of counties which had been declared disaster areas was obtained from O.E.P. Rosters of local coordinators were obtained from state directors and the local coordinators were matched with the counties. In addition, each state director was asked to provide a list of coordinators who were known to have assumed operational roles in disaster situations. These recommended coordinators were incorporated into the sample in roughly three cases where they did not already appear on our lists. One such case was found in Iowa where a county civil defense director had experienced a tornado which had practically destroyed a small community. However, the area was not declared a disaster area as the cost fell slightly short of the requirements set up by O.E.P. and the state of Iowa for a disaster declaration. These civil defense directors were added to our sample as the disasters were known to be relatively severe and the state C.D./O.E.P. directors stated that the areas, in their opinion, should have been or would soon be declared a disaster area.

During the period from August 9-21, telephone calls were initiated with 128 coordinators in Iowa, Illinois, South Dakota and Minnesota. The calls lasted from 10 to 30 minutes. Interviews were arranged with fifty-seven directors to obtain the additional data needed to complete the research. The interviews took place from August 15 to September 3. A letter was sent to each director reminding him of the interview. Four interviewers from Iowa State University were utilized to obtain the interviews which ranged in length from about two hours to five and one-half hours. A total of three persons refused to be interviewed after the arrangements were made, and a total of twenty were not available for phone screening during the period specified for our calls or interviews even though repeated efforts (at least four calls) were made to contact them. However, approximately forty-one (40.6) percent of those telephoned were scheduled for interviews in order to obtain the additional data. Completed interviews with comparable data was obtained from fifty-nine (59) coordinators as the five pretest coordinators were added to the sample.

Scaling the Variables

The purpose of this section is to briefly describe the methods used to assign numbers or score the items utilized in the interview schdule. The method of scoring utilized for most of the items is the certainty method described by Warren et al. (1969), Warren and Specht (1970) and utilized by Schmitz (1971). When methods other than the certainty method are utilized, this will be noted when discussing particular variables in this chapter.

When utilizing the certainty method visualized as a "response framework." the respondent was asked to make two different decisions. The first was a judgment of direction such as agree or disagree. The second decision is one of certainty ranging from midly certain to very certain. The following framework was presented to the respondent on a response card utilized as an aid in using the certainty method and illustrates the use of the certainty method as a response framework.

Agree					
	1	2	3	4	5
Disagree					

The respondents were interviewed and asked to respond to a series of opinions or attitude statements which were scored in the following ways depending on whether theory suggested a particular response should be scored high or low:

A5	A4	A3	A2	A1	A&D	D1	D2	D3	D4	D5
00	03	05	06	07	08	09	10	11	13	16

or

D5	D4	D3	D2	D1	A&D	A1	A2	A3	A4	A5
00	03	05	06	07	08	09	10	11	13	16

It should be emphasized that the certainty method of scoring allows the assignment of larger values to end points of the continuum and, therefore, equal intervals between response categories are not assumed.

Each item utilized in the construction of scales was transformed to Z scores (normalized) through the following formula (Nie et al., 1970):

$$Z = \frac{X - \bar{X}}{s}$$

Where X equals the value of the variable to be normalized, $\bar{X}$ equals the mean for the item and s equals the standard deviation of the variable. The means for each item are near 0 and the standard deviations near 1.0 for each item utilized in scale construction as indicated in Table 3.4.

An attempt will be made in this dissertation to assess whether the items utilized to measure the variables possess the characteristics of additive scales. It was decided to utilize empirical evidence such as intercorrelation of items and item total correlations to evaluate whether the items used possessed the properties of scales. The major criteria utilized are additivity plus external validation.

The first criterion (Warren et al., 1969) is that the responses to items must be linearly related. This criterion is evaluated through the utilization of the following three conditions. These three conditions are summarized in Table 3.1, Table 3.2, Table 3.3 and Table 3.4.

1. The minimum acceptable item total correlation coefficient (r_{it}) and the calculated item total correlation (r_{it}) are compared for each scale. This information is summarized in Table 3.1 and Table 3.2.

2. The average intercorrelation coefficient ($\bar{r}_{ij}$) was calculated. This information is summarized in Table 3.1.

3. The coefficients of reliability (r_{tt}) defined by Richardson (Warren et al., 1969:14) as:

$$r_{tt} = \frac{n\ (\bar{r})}{1 + (n-1)(\bar{r})}$$

   where n is the number of items in the scale and $\bar{r}$ is the average intercorrelation among the items. This information is summarized in Table 3.1.

The magnitude of the intercorrelation (r_{ij}) will be inspected to determine if the magnitudes of the r_{ij}'s are sufficiently large to justify listing the items together as a scale. This information is summarized in Table 3.3.

The second criterion for additivity is that the variance of the response to the items must be "homogeneous and independent of the means" (Warren et al., 1969). The pattern of relationships is evaluated by inspecting the relationships between the means, standard deviations and range of the standard deviations. A pattern of relationships, if they exist, must be noted. It should be pointed out that for most of the scales, the number of items are small and have been transformed to Z scores. Evaluations, therefore, are tenuous at best. The range, standard deviations and means for each transformed item as well as for the total scores are summarized in Table 3.4. The means are near 0 and the standard deviation near 1.0 for most items utilized as indicated in Table 3.4.

The third criteria of additivity (Warren et al., 1969) is that the item intercorrelations (r_{ij}) must be both positive and homogeneous. This criteria will be evaluated on the basis of examination of the item intercorrelations. The smaller the range that includes sixty (60) percent or more of the intercorrelations, the more homogeneous the correlation. It appears difficult to evaluate adequately this criteria with a relatively small number of items such as are found in this study. However, the range of the concentration of the intercorrelations among the items is summarized in Table 3.3. It should be noted that for the most part, there are positive intercorrelations with a moderate range.

Correction for attenuation

In this dissertation, the goal is building a theory to explain response to disaster and not testing theory or estimating magnitudes of the path coefficients. The research should be regarded as exploratory. For these reasons, no correction for attenuation will be attempted before utilizing path analysis statistical techniques. Measurement error is believed to exist, and it recognized that the problem of measurement error may be compounded through the utilization of equations with several variables since a variable with relatively low reliability may affect other path values (Heise, 1969 and Warren and Lee, 1971). In addition to measurement error, Bohrnstedt (1969) points out that the problem of sampling error should be considered. The reliability estimates provided previously cannot be plugged into a correction for attenuation equation to obtain true magnitudes for the path coefficients. The reason is that the correction for attenuation equations correct for measurement error and not sampling error. Of course, without the correction for attenuation, some path values will be too high and others will be too low (Bohrnstedt, 1969:124). The findings reported in this dissertation in Chapter 4 should, as a result, be regarded as tentative as well as exploratory. Theory testing procedures must be utilized in future research and correction for attenuation should be a part of the future research.

A comparison of uncorrected correlation coefficients and correlation coefficients corrected for attenuation will be attempted in Chapter 4. The purpose of this comparison is to determine the possible effects that correction for attenuation would have on the results and to determine if measurement error had an effect on the reported results. The assumption that measurement errors are randomly distributed will be made in order to correct for attenuation (Warren and Lee, 1971).

Measuring the variables

In the following section of the dissertation, each variable will be presented and operationally defined. Additional summary evidence as to the scalability of the items utilized to measure each variable will be presented.

X_1 Building system role performance   Building system role performance refers to the behavior of the civil defense coordinator relevant to his job in the building system. Role performance was measured by three items utilizing a ten-point scoring method plus a score made up of five (5) items utilizing a five-point scoring method. The items and the coding instructions are found in Appendix A. Three items were designed to determine the nature and extent of coordination utilized by coordinators. Five items were designed to reflect the extent of civil defense involvement with other agencies such as the police and fire departments.

A building system role performance score was developed in the following way. First, a coordination score was developed by adding the three transformed coordination items scored with ten-point scoring method. Second, an involvement score was developing by adding the five transformed items scored with the five-point scoring method. Third, the involvement score was added to the coordination score to produce the building system role performance score. This score reflects the extent and type of coordination utilized by the local C.D. coordinators plus the degree of involvement of civil defense with other agencies in local government. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4.

The minimum acceptable intercorrelation for building system role performance is .38, and none of the items measuring building system role performance items were deleted. The average intercorrelation coefficient ($\bar{r}$) is .70. The reliability coefficient (r_{tt}) is .90. The range of intercorrelation is from .42 to .98, and the range that includes sixty percent of the intercorrelations is from .44 to .97. The score developed for building system role performance meets the criteria for a scale. The characteristics of the distribution of the scale scores are as follows for the building system role performance. The actual range was from -4.13 to 104.29. The mean was 3.50, the standard deviation was 19.10.

$\underline{X_2}$ <u>Severity of the disaster</u> Disaster is defined as evaluation of the seriousness of the impact of a disaster agent on selected aspects of the social life of the area. The initial measure of the variable used in the model is based on respondent ratings of four items. The items reflected aspects of an area that might be affected by the disaster such as traffic, government operation, hospital operations and essential community services.

The minimum acceptable intercorrelation for severity of the disaster is .45; one item was dropped which did not meet this minimum. The average intercorrelation coefficient ($\bar{r}$) is .24. The reliability coefficient (r_{tt}) is .65. The range of intercorrelations is from .13 to .39, and the range that includes sixty percent of the intercorrelations is from .17 to .27. The score developed for severity of disaster appears to meet the criteria established for a scale relatively well. A ten-point scoring procedure was utilized for each of the four items. A disaster severity composite score was developed by adding four items. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The items as well as the coding procedures utilized are presented in Appendix B. The characteristics of the distribution of scale scores are as follows. The actual range of scores was from -4.09 to 7.94; the mean was .00 and the standard deviation is 2.62.

$\underline{X_3}$ Warning Warning refers to the length of warning prior to the arrival of the disaster agent. Warning was measured by one item in which the respondent was asked the length of warning in hours. The item and the coding instructions are found in Appendix Table C.

A warning score or index was developed by utilizing the single item. No evidence for scalability is possible in this case as only the single item is utilized. The characteristic for the distribution for the warning item is as follows. The actual range was from -1.01 to 23.13. The mean was 3.92; the standard deviation was 8.80.

X_4 Uncertainty Uncertainty refers to the perceived degree of awareness of the patterns of activity required to accomplish recovery related tasks. Uncertainty was measured by five items utilizing the certainty method of scoring for each item. The items and coding instructions are presented in Appendix D. The five items were designed to measure the degree to which the coordinator and others anticipated the demands they encountered in responding to a disaster and knew how to respond.

The minimum acceptable intercorrelation (r_{it}) is .45, and no items were deleted from the original scale. The average intercorrelation coefficient ($\bar{r}$) is .70. The reliability coefficient (r_{tt}) is .92. The range of intercorrelations is from .55 to .84, and the range that included sixty percent of the intercorrelations is from .59 to 77. The score developed for uncertainty meets the criteria established for a scale very well. The composite score for uncertainty was developed by adding the responses for each item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores are as follows. The actual range was from -4.13 to 7.81. The mean was .00; the standard deviation was 4.36.

X_5 Role conflict Role conflict refers to inconsistent or conflicting role expectations perceived by the civil defense coordinators as a result of multiple-group membership. Role conflict was measured by five items utilizing the certainty method of scoring for each item. The items and coding procedures utilized in this study are presented in Appendix E. The items were designed to measure the extent to which the coordinator and others experienced conflicting pressures from differing groups and agencies.

The minimum acceptable intercorrelation (r_{it}) for role conflict is .45, and none of the items were deleted from the initial formulation. The average intercorrelation ($\bar{r}$) is .27. The reliability coefficient (r_{tt}) is .65. The range of intercorrelation is from .04 to .60, and the range that includes sixty percent of the intercorrelations is from .13 to .42. The score developed for role conflict appears to meet the criteria established for a scale relatively well. The composite score for role conflict was developed by adding the responses for each item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores for role conflict are as follows. The actual distribution was from -3.59 to 8.74; the mean was .00, and the standard deviation was 3.23.

$\underline{X_6}$ <u>Stress</u> Stress refers to the perceived demands placed on the organization and individual in terms of the time and resources. Stress was measured by six items utilizing the certainty method of scoring. The items and coding procedures utilized are presented in Appendix F. The items were designed to measure the extent of demands experienced by the coordinator and others following a disaster.

The minimum acceptable correlation (r_{it}) for stress is .41, and none of the items were deleted from the original formulation. The average intercorrelation coefficient ($\bar{r}$) is .38. The reliability coefficient (r_{tt}) is .78. The range of intercorrelations is .06 to .69, and the range that includes sixty percent of intercorrelations is from .31 to .50. The score developed for stress meets the criteria established for a scale very well. The composite score for stress was developed by adding the responses for each item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores are as follows. The actual range was from -9.45 to 5.82. The mean was -.00; the standard deviation was 4.15.

$\underline{X_7}$ Social disorganization Social disorganization refers to the disorganizing effect upon aspects of social life following the impact of a disaster agent of some type. Social disorganization was believed composed of three elements--role conflict, stress and uncertainty. A social disorganization score was developed by adding the responses for the three scales developed earlier. Role conflict, stress and uncertainty responses were added together.

Social disorganization was essentially measured by sixteen items. As role conflict, stress and certainty were judged to constitute additive scales, it was deemed appropriate to add these in order to produce a composite score for social disorganization. The characteristics of the distribution of scale scores are as follows for social disorganization. The actual range was from -13.95 to 14.91. The mean was .00; the standard deviation was 6.93.

$\underline{X_8}$ Organizational autonomy Organizational autonomy refers to the degree to which an organization is able to control its own activity and environment following a disaster. Organizational autonomy was measured by four items utilizing the certainty method of scoring. The items and coding procedures are presented in Appendix G. The items were designed to measure the extent to which the coordinator and others maintained independence of action or cooperated in response to the disaster.

The minimum acceptable correlation (r_{it}) is .41, and two of the original six organizational autonomy items were deleted leaving four items in the scale. The average intercorrelation coefficient ($\bar{r}$) is .36. The range of intercorrelations is from .17 to .77, and the range of intercorrelation that includes sixty percent of the intercorrelations is from .26 to .35. The reliability coefficient (r_{tt}) is .69. The score developed for stress meets the criteria established for a scale. The composite score for organizational autonomy was developed by adding the responses from each item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores are as follows. The range of scores was from -3.40 to 6.81. The mean was .00; the standard deviation was 2.88.

$\underline{X_9}$ <u>Need for information</u> Need for information refers to the per ceived need for data in regard to disaster impact and the appropriate response. Need for information was measured by six items utilizing the certainty method of scoring. The items and coding instructions utilizing are presented in Appendix H. The need for information items were designed to measure the extent to which the coordinator and others needed data in terms of the recovery related activities of other individuals, agencies and departments.

The minimum acceptable intercorrelation (r_{it}) is .41, and one item from the original seven need for information items was deleted. The average intercorrelation coefficient ($\bar{r}$) is .18. The reliability coefficient (r_{tt}) is .53. The range of intercorrelations is from -.03 to .43, and the range of intercorrelations that includes sixty percent of the intercorrelations is .12 to .22. The score developed for need for information meets many of the criteria established for a scale, but the reliability coefficient (r_{tt}) is relatively low. Improvement in measurement is indicated for future research. The composite score for need for information was developed by adding the responses for each individual item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores are as follows. The actual range was from -8.79 to 4.85. The mean was -.00; the standard deviation was 2.94.

$\underline{X}_{10}$ <u>Communication</u>   Communication is a symbolic means of conveying messages from a sender through a channel to a receiver. Communication was measured by eight items utilizing the certainty method of scoring for each item. The items and the coding instructions are found in Appendix I. The communication items were designed to measure the extent and nature of communication between the coordinator and others following the disaster.

The minimum acceptable intercorrelation (r_{it}) is .36, and none of the original items were deleted. The average intercorrelation coefficient ($\bar{r}$) is .17. The reliability coefficient (r_{tt}) is .86. The range of intercorrelations for communication is from -.18 to .43, and the range that includes sixty percent of the intercorrelations is from .03 to .28. The score developed for communication meets the criteria established for a scale. A communication score was developed by adding the responses for each item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores are as follows. The actual range was from -3.27 to .59. The mean was .00; the standard deviation was 4.76.

$\underline{X_{11}}$ <u>Rank</u> Rank refers to the perceived status of the civil defense coordinator following the disaster. Rank was measured by four items utilizing the certainty method of scoring and one item utilizing a ten-point scoring technique. The items and coding procedures are presented in Appendix J. The items were designed to measure the extent to which the coordinator perceived an increase in his rank and perceived that others sought his assistance and advice in recovery from the disaster.

The minimum acceptable intercorrelation (r_{it}) is .45, and none of the original rank items were deleted. The average intercorrelation coefficient ($\bar{r}$) is .21. The reliability coefficient (r_{tt}) is .58. The range of intercorrelations is from .03 to .60, and the range that includes sixty percent of the intercorrelations is from .23 to .40. The score developed for rank meets many of the criteria established for a scale, but the reliability coefficient (r_{tt}) is relatively low. Improvement in measurement is indicated as necessary for future research. The composite score for rank was developed by adding the responses for each item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores are as follows. The actual range of scores was from -8.31 to 3.84. The mean was .00; the standard deviation was 3.36.

$\underline{X_{12}}$ Norms Norm refers to the emergent written and unwritten rules prescribing acceptable and unacceptable behavior following a disaster. Emergent norms were measured by six items utilizing the certainty method of scoring. The items and coding procedures used are presented in Appendix K. The norms itmes were designed to measure the extent to which standards emerge following a disaster that emphasize cooperation and encourage effective recovery operations.

The minimum acceptable intercorrelation (r_{it}) is .41, and none of the original six items were deleted. The average intercorrelation coefficient ($\bar{r}$) is .13. The reliability coefficient is .51. The range of intercorrelations for communication is from -.19 to .43, and the range that includes sixty percent of the intercorrelations is from .08 to 27. The score developed for norms meets many of the criteria for a scale, but the reliability coefficient (r_{tt}) is relatively low. Improvement in measurement is indicated as necessary for future research. The composite score for emergent norms was developed by adding the responses from each item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores are as follows. The actual range of scores was from -8.82 to 4.87. The mean was -.00; the standard deviation was 3.23.

$\underline{X_{13}}$ Operating system role performance Role performance in the operating system refers to the behavior of the civil defense coordinator relevant to his job in the operating system. Operating system role performance was measured by ten items of which eight utilized the certainty method of scoring and two utilized the ten point scale. The items and the coding instructions are found in Appendix L. Eight items were designed to measure the extent to which the coordinator performed tasks such as advising, briefing others, holding meetings, making policy decisions and so on. Two additional items were designed to measure the extent of coordination engaged in by the coordinator.

The minimum acceptable intercorrelation (r_{it}) is .30, and one item from the original eleven operating system role performance items was deleted. The average intercorrelation coefficient ($\bar{r}$) is .18. The reliability coefficient (r_{tt}) is .68. The range of intercorrelations is from -.16 to .70, and the range that includes sixty percent of the intercorrelations is from .01 to .42. The score developed for operating system role performance meets the criteria established for a scale relatively well. The composite role performance score was developed by adding the responses on each item. Evidence for the scalability of this variable is presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. The characteristics of the distribution of scale scores are as follows. The actual range was from -15.62 to 7.77. The mean was -.00; the standard deviation was 5.07.

Statistical Procedures

Path analysis is a model building procedure utilized in the analysis of the data collected for this dissertation as the researcher is interested in determining which of the variables to include in the model and determining existence of path relationships between the variables. It will be assumed that the reader has some knowledge of the techniques to be employed. Thus, the purpose of this section is to briefly introduce and

Table 3.1. Minimum acceptable intercorrelation, reliability coefficient and average intercorrelation coefficient listed for each variable

Variable	Minimum Acceptable Intercorrelation (r_{it})	Reliability Coefficient (r_{tt})	Average Intercorrelation Coefficient ($\bar{r}$)
Building system role performance (X_1)	.38	.90	.70
Disaster (X_2)	.45	.65	.24
Warning (X_3)	--	--	--
Uncertainty (X_4)	.45	.92	.70
Role conflict (X_5)	.45	.65	.27
Stress (X_6)	.41	.78	.38
Organizational autonomy (X_8)	.41	.69	.36
Need for information (X_9)	.41	.53	.18
Communication (X_{10})	.36	.86	.17
Rank (X_{11})	.45	.58	.21
Norms (X_{12})	.41	.51	.13
Operating system role performance (X_{13})	.30	.68	.18

Table 3.2. Number of items in initial scale, number of items deleted and number of items in the scale for each variable

Variable	Number of Items in Initial Scale	Number of Items Deleted	Number of Items in Scaled Variable
Building system role performance (X_1)	7	3	4
Disaster (X_2)	5	1	4
Warning (X_3)	1	-	1
Uncertainty (X_4)	5	-	5
Role conflict (X_5)	5	-	5
Stress (X_6)	6	-	6
Organizational autonomy (X_8)	6	2	4
Need for information (X_9)	7	1	6
Communication (X_{10})	8	-	8
Rank (X_{11})	5	-	5
Norms (X_{12})	6	-	6
Operating system role performance (X_{13})	11	1	10

Table 3.3. Range of item intercorrelations for each scale utilized to measure the variables

Variable	Number of Items in Scale	Range of Intercorrelations	Range that Includes 60% of the Intercorrelations
Building system role performance (X_1)	4	.42 to .98	.44 to .97
Disaster (X_2)	4	.13 to .39	.17 to .27
Warning (X_3)	1	-----	-----
Uncertainty (X_4)	5	.55 to .84	.59 to .77
Role conflict (X_5)	5	.04 to .60	.13 to .42
Stress (X_6)	6	.06 to .69	.31 to .50
Organizational autonomy (X_8)	4	.17 to .77	.26 to .35
Need for information (X_9)	6	-.03 to .43	.12 to .22
Communication (X_{10})	8	-.18 to .43	.03 to .28
Rank (X_{11})	5	.03 to .60	.23 to .40
Norms (X_{12})	6	-.19 to .43	.08 to .27
Operating system role performance (X_{13})	10	-.16 to .70	.01 to .42

Table 3.4. The mean and standard deviation for each item in each scale plus total scores following Z score transformation on each item

Item and Total Scores Following Z Score Transformation	n	Mean	Standard Deviation
Item 1	59	1.12	.795
Item 2	59	1.22	6.62
Item 3	59	1.17	6.35
Item 4	59	0.00	.46
Building system role performance (X_1)	59	0.00	.46
Item 1	59	0.00	1.00
Item 2	59	0.00	1.00
Item 3	59	0.00	1.00
Item 4	59	0.00	1.00
Disaster (X_2)	59	0.00	2.62
Warning (X_3)	59	3.92	8.80
Item 1	59	0.00	1.00
Item 2	59	-0.00	1.00
Item 3	59	0.00	1.00
Item 4	59	0.00	1.00
Item 5	59	-0.00	1.00
Uncertainty (X_4)	59	0.00	4.36
Item 1	59	-0.00	1.00
Item 2	59	0.00	1.00
Item 3	59	-0.00	1.00
Item 4	59	0.00	1.00
Item 5	59	0.00	1.00
Role conflict (X_5)	59	0.00	3.23

Table 3.4. (Continued)

Item and Total Scores Following Z Score Transformation	n	Mean	Standard Deviation
Item 1	59	-0.00	1.00
Item 2	59	-0.00	1.00
Item 3	59	0.00	1.00
Item 4	59	-0.00	1.00
Item 5	59	0.00	1.00
Item 6	59	-0.00	1.00
Stress (X_6)	59	-0.00	4.15
Social Disorganization (X_7)	59	0.00	6.93
Item 1	59	-0.00	1.00
Item 2	59	0.00	1.00
Item 3	59	0.00	1.00
Item 4	59	0.00	1.00
Organizational autonomy (X_8)	59	0.00	2.88
Item 1	59	0.00	1.00
Item 2	59	0.00	1.00
Item 3	59	0.00	1.00
Item 4	59	-0.00	1.00
Item 5	59	-0.00	1.00
Item 6	59	-0.00	1.00
Need for information (X_9)	59	-0.00	2.94
Item 1	59	0.00	1.00
Item 2	59	-0.00	1.00
Item 3	59	-0.00	1.00
Item 4	59	-0.00	1.00
Item 5	59	-0.00	1.00
Item 6	59	0.00	1.00

Table 3.4. (Continued)

Item and Total Scores Following Z Score Transformation	n	Mean	Standard Deviation
Item 7	59	0.00	1.00
Item 8	59	-0.00	1.00
Communication (X_{10})	59	0.00	4.76
Item 1	59	-0.00	1.00
Item 2	59	0.00	1.00
Item 3	59	0.00	1.00
Item 4	59	-0.00	1.00
Item 5	59	0.00	1.00
Rank (X_{11})	59	0.00	3.36
Item 1	59	0.00	1.00
Item 2	59	-0.00	1.00
Item 3	59	-0.00	1.00
Item 4	59	0.00	1.00
Item 5	59	0.00	1.00
Item 6	59	0.00	1.00
Norms (X_{12})	59	0.00	3.23
Item 1	59	-0.00	1.00
Item 2	59	-0.00	1.00
Item 3	59	0.00	1.00
Item 4	59	0.00	1.00
Item 5	59	0.00	1.00
Item 6	59	0.00	1.00
Item 7	59	-0.00	1.00
Item 8	59	0.00	1.00

Table 3.4. (Continued)

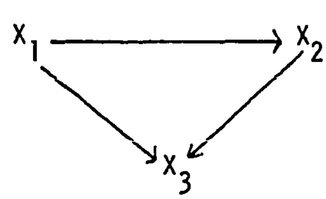
Item and Total Scores Following Z Score Transformation	n	Mean	Standard Deviation
Item 9	59	0.00	1.00
Item 10	59	-0.00	1.00
Operating system role performance (X_{13})	59	-0.00	5.07

describe path analysis along with the assumptions and advantages associated with its uses. A set of recursive regression equations are presented to represent the models introduced in the previous chapter.

The principal source material utilized for the statistics procedures is as follows: Blalock (1960, 1964, 1969), Duncan (1966), Draper and Smith (1966), Snedecor and Cochran (1967), Huntsberger (1967), Schmitz (1971), Paulson (1971), Mulford et al. (1971) and Warren et al. (1968).

Path analysis

Path analysis is a statistical procedure based on regression principles in which several independent variables and dependent variables are considered. Each of the dependent variables are in a unique regression equation with a different set of independent variables. The set of such equations are recursive in that each of the dependent variables are preceded (in time) and predicted by independent variables. For example, the causal (path) model such as:



would be represented by a set of recursive regression equations in the following form:

$$X_2 = b_{21}X_1 + e_2$$

$$X_3 = b_{31}X_1 + b_{32}X_2 + e_3$$

The equation might also be written in path notation where P would represent the standardized regression coefficient. The variable X_1 is referred to as an exogenous variable which means that it has no cause which is specified in the particular model being considered. The exogenous variable is set equal to its random deviation, e_1.

The use of path analysis typically follows the steps (Warren et al., 1968) which are outlined below:

1. The first step is to draw a causal model diagram. This step was completed in Chapter 2.

2. The second step is to obtain a set of regression equations which represent the causal model diagram constructed in step 1. This step is completed in Chapter 3.

3. The third step is to obtain the partial F values for each path coefficient in each of the equations. This and the following steps are completed in Chapter 4.

4. The fourth step in path analysis is to drop all variables from the equation which do not have significant partial F values for the coefficients.

5. The fifth step is to repeat steps 2 through 4 until all the partial F values are significant. Duncan (1969) and Warren and Lee (1971) have pointed out the problems associated with using the same data to specify a model and estimate the magnitude of the coefficients. The purpose of the present research is to specify a model and not estimate the magnitude of the coefficients.

6. The sixth step is to standardize the path coefficients. These standardized coefficients are termed path coefficients and they allow the researcher to directly compare the weights or coefficients between equations.

7. The seventh step is to note the path values on the path arrows on the causal model. Non-significant partial regression coefficients have been eliminated by removing these arrows from the diagram.

8. The eighth step is to calculate the amount of variance which was not explained by the hypothesized relationships. These values are then entered into the causal diagram as a causal path, and this path is a representation of the effects of all variables which were not included in the original causal model.

The partial "F" value that is used to determine if the regression coefficient is to remain in the equation is that which corresponds to a probability of .10 or less that a coefficient might occur by chance. This relatively liberal value was chosen because of the exploratory nature of the present research. The .05 or .01 significance levels were not utilized because it was felt that these more conservative levels would lead to the rejection of many potentially significant paths.

The theoretical models presented in Figure 13 and 14 are of central concern. The set of recursive equations for Model I (Figure 13) are as follows:

eq. 1 $X_4 = b_{41}X_1 + b_{42}X_2 + b_{43}X_3 + e_4$

eq. 2 $X_5 = b_{51}X_1 + b_{52}X_2 + e_5$

eq. 3 $X_6 = b_{62}X_2 + e_6$

eq. 4 $X_8 = b_{84}X_4 + b_{86}X_6 + e_8$

eq. 5 $X_9 = b_{93}X_3 + b_{95}X_5 + b_{96}X_6 + e_9$

eq. 6 $X_{10} = b_{104}X_4 + b_{106}X_6 + b_{108}X_8 + e_{10}$

eq. 7 $X_{11} = b_{111}X_1 + b_{116}X_6 + b_{1110}X_{10} + b_{1012}X_{12} + e_{12}$

eq. 8 $X_{12} = b_{122}X_2 + b_{125}X_5 + b_{126}X_6 + b_{129}X_9 + b_{1210}X_{10} + e_{12}$

eq. 9 $X_{13} = b_{131}X_1 + b_{134}X_4 + b_{136}X_6 + b_{138}X_8 + b_{139}X_9 + b_{1310}X_{10} + b_{1311}X_{11} + b_{1312}X_{12} + e_{13}$

The complete set of recursive regression equations for Model II (Figure 14) is as follows:

eq. 1' $X_7 = b_{71}X_1 + b_{72}X_2 + e_7$

eq. 2' $X_8 = b_{87}X_7 + e_8$

eq. 3' $X_9 = b_{93}X_3 + b_{97}X_7 + e_9$

eq. 4' $X_{10} = b_{107}X_7 + b_{108}X_8 + b_{109}X_9 + e_{10}$

eq. 5' $X_{11} = b_{111}X_1 + b_{117}X_7 + b_{1110}X_{10} + b_{1112}X_{12} + e_{11}$

eq. 6' $X_{12} = b_{121}X_1 + b_{122}X_2 + b_{127}X_7 + b_{129}X_9 + b_{1210}X_{10} + e_{12}$

eq. 7' $X_{13} = b_{131}X_1 + b_{138}X_8 + b_{139}X_9 + b_{1310}X_{10} + b_{1311}X_{11} + b_{1312}$

$X_{12} + e_{13}$

Statistical assumptions

The statistical procedures described above are used in this research as a theory building tool. They are not utilized for theory testing or for descriptions of the population. A liberal position is taken in regard to significance level as described earlier in this chapter ($\alpha = .10$) to avoid premature rejection of theoretically important paths.

The following assumptions (Warren et al., 1968; Paulson, 1971; Schmitz, 1971) apply to path analysis:

1. The variables are additive. The first portion of Chapter 3 is devoted to a determination of whether this assumption is met with this data. The variables appear to be additive.

2. The observations should be independent and random. The observations may not be assumed as random since the sample was purposive in nature. The observations, however, may be assumed to be independent.

3. The third assumption for path analysis is that the variables are normally distributed. Each item of each scale utilized in the present work was transformed to Z score values and inspection of the distribution of the items leads to the conclusion that the variables are reasonably normally distributed.

4. The fourth assumption for path analysis is that the variables are measured with little or no error. The assumption is made for the purposes of the research that there is little measurement error. Correction for attenuation is not attempted before utilization of path analysis procedures. Comparisons of uncorrected and correlations corrected for attentuation

will, however, be made to evaluate effects of possible measurement error.

5. The fifth assumption is that the relationships among the variables are linear. The assumption is made for the purpose of this research that the variables are linearly related.

6. The sixth assumption is that all the variables that are relevant to the model have been included and the errors are uncorrelated. For the purposes of the present research, it is assumed that all relevant variables have been identified and included. The residual paths are included in the analyses to provide an estimate of the effect of any variables not in the model.

7. The seventh assumption for path analysis is that the hypothesized causal relationships are asymmetrical. It should be noted that only asymmetrical causal relationships are posted in the verbal theory and regression equations.

Advantages of path analysis

This dissertation utilizes path analysis as a technique for model building. This technique has several advantages over some of the other types of model building such as multiple regression, stepwise regression and others. These advantages as identified by Coward (1969:123) include:

1. Path analysis allows the researcher to identify, measure and describe complex networks of relationships.

2. Path analysis allows both direct and indirect causal relationships to be identified, measured and described.

3. Path analysis allows the researcher to identify an ordering of the variables as well as their identification for the regression equations.

4. Path analysis allows an emphasis on both prediction and explanation.

The emphasis in this dissertation is identifying networks of relationships and specifying the direct and indirect ordering of causal relationships. The emphasis, in other words, is upon building a "structural"

(Heise, 1969:41) model where the researcher is attempting to discover a set of equations permitting prediction of how a change in one variable affects change in other variables in the system as specified in advance by theory.

CHAPTER 4. RESEARCH FINDINGS

Introduction

Causal model refers to various forms of multivariate analysis where the relationships among the variables are hypothesized to be either causally or non-causally related either directly or indirectly to the dependent variables. Path analysis is the causal modeling technique utilized in this dissertation. Land (1969) indicated that causal models consist of three parts. The first is a verbal explanation of the relationships as in Chapter 2. The second part is a diagram to represent the hypothesized verbal relationships. This part was also developed in Chapter 2 (Figures 13 and 14). The third part of a causal model is a set of recursive equations that represent the causal diagram. This set of equations was presented in Chapter 3.

Previous research on response to disasters has focused only on case studies of disaster. No previous attempt has been made to utilize either single or multiple regression techniques to explain or predict the dependent variables or to test hypotheses. There have been no causal models developed and little attention was devoted to the construction of logical models. This dissertation is devoted to developing a logical, temporal model based on numerous case studies and other information to determine the existence of significant path relationships between variables and determine which variables to include in the model. The objectives of this chapter, then, are to determine the variables to be included in the model and the existence of the path relationships among the variables, and a tentative estimate of magnitudes of coefficients. The findings, related to the two models developed earlier, will be presented. Also, an evaluation is attempted in regard to which final model appears to best represent the theory.

Path Analysis as a Technique for Model Building

Sewall Wright (1921, 1934, 1954, 1960), a geneticist, is generally given credit for developing path analysis. Herbert Simon (1954) developed a causal modeling technique utilizing correlation coefficients, but this technique was apparently based on the work of Wright and similar work by various econometricians (Meuller, 1967). Duncan (1966) reports that Blalock (1964) is credited with introducing causal models to sociology. Others such as Duncan (1966) and Boudon (1965) have contributed to the development and use of causal modeling techniques. The techniques of path analysis have come to be fairly well accepted in sociology.

The path analysis technique allows the effects of a system of interrelated variables as specified in the causal model to be considered at one time. All the path analyses in Cahpter 4 are based on models illustrated in Figure 13 and Figure 14 and represented by the recursive equations developed in Chapter 3. The results of the first step in the analysis will be presented in terms of standardized regression coefficients or path values and the partial F values. Also, the final step of the analysis will be presented which will include a final path diagram with all path coefficients that are significant at the .10 level. The intermediate steps in the analysis will not be presented or discussed. The objective now becomes one of testing the model for "goodness of fit" with the data collected from civil defense coordinators.

Findings for Model I

Model I is the more complex of the two models presented in that a greater number of variables and relationships were considered. The findings are presented for all paths found to be significant in Table 4.2 and the path diagram found in Figure 15. These findings for Model I are discussed in the following section in terms of direct effects on the variables. Generally, for Model I, seventeen of the thirty-three hypothesized paths were supported by the data.

Determination of path coefficients for Model I

A recursive set of equations was written to represent the path diagrams developed in Chapter 2. The recursive sets of equations were presented in Chapter 3. The next step in path analysis is to calculate the regression coefficients for the nine regression equations that were presented.

In order to evaluate whether or not the variables utilized in the recursive equations should remain in the equation, a significance test is performed. For each regression coefficient, the null hypothesis $\beta = 0$ is tested. The test of no linear relationships is the one that is tested with this procedure. For this dissertation, a fairly liberal test of significance was utilized in order to prevent the rejection of possible important and significant paths. This procedure was viewed as justified by the exploratory nature of the research. The .10 level of significance was utilized. This means that the probability of error due to chance is ten percent.

Following the calculation of regression coefficients, an F test is utilized for each of the coefficients. If a calculated coefficient compared to a tabular F significance value of .01 is found to be non-significant, it is eliminated from the equation. All path coefficients for Model I are presented in Table 4.1. The values represented in these two tables are for the initial determination of significant paths, and all theoretical paths with the F value for each is included.

The non-significant path coefficients were eliminated and a new set of recursive equations were developed, and a new set of regression coefficients were calculated. This procedure was repeated until each regression equation in Model I contained only coefficients that were significant at the .10 level.

For Model I, the elimination of paths that were not significant resulted in a new set of recursive equations. These equations are as follows.

eq. 1 $X_5 = b_{51}X_1 + b_{52}X_2 + e_5$

eq. 2 $X_6 = b_{62}X_2 + e_6$

eq. 3 $X_8 = b_{86}X_6 + e_8$

eq. 4 $X_9 = b_{95}X_5 + b_{93}X_3 + e_9$

eq. 5 $X_{10} = b_{106}X_6 + e_{10}$

eq. 6 $X_{11} = b_{111}X_1 + b_{1112}X_{12} + e_{11}$

eq. 7 $X_{12} = b_{122}X_2 + b_{126}X_6 + b_{129}X_9 + b_{1210}X_{10} + e_{12}$

eq. 8 $X_{13} = b_{134}X_4 + b_{1311}X_{11} + e_{13}$

This new set of recursive equations is represented by the path diagram which is illustrated in Figure 15.

Table 4.1. The initial determination of significant paths: Preliminary data analysis for Model I: Partial regression analysis.

DEPENDENT and Independent Variables[1]	"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_4 UNCERTAINTY				.08
X_1 Building system role performance	2.38	-.05	-.20	
X_2 Disaster	1.37	-.26	-.15	
X_3 Warning	1.35	.07	.15	
X_5 ROLE CONFLICT				.27
X_1 Building system role performance	17.15*	.08	.48	
X_2 Disaster	7.16*	.38	.31	
X_6 STRESS				.23
X_2 Disaster	17.35*	.77	.48	
X_8 ORGANIZATIONAL AUTONOMY				.09
X_4 Uncertainty	.17	-.03	-.05	
X_6 Stress	5.15*	.20	.29	

[1]Each variable is a part of a network of variables that may be expressed as either independent or dependent variables. In this table, the dependent variable is identified by upper case type and independent variables by lower case type.

*"F" values significant at the .10 level.

Table 4.1. (Continued)

DEPENDENT and Independent Variables[1]		"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_9	NEED FOR INFORMATION				.16
	X_3 Warning	6.92*	.11	.33	
	X_5 Role conflict	1.86	.16	.18	
	X_6 Stress	.55	.07	.10	
X_{10}	COMMUNICATION				.09
	X_4 Uncertainty	1.85	.20	.18	
	X_6 Stress	2.27*	.23	.20	
	X_8 Organizational autonomy	1.18	.09	.15	
X_{11}	RANK				.21
	X_1 Building system role performance	2.13	.03	.18	
	X_6 Stress	.86	.10	.12	
	X_{10} Communication	.06	.03	.04	
	X_{12} Norms	3.98*	.33	.32	
X_{12}	NORMS				.51
	X_2 Disaster	2.25*	.20	.17	
	X_5 Role conflict	1.08	.11	.11	
	X_6 Stress	2.15*	.13	.17	
	X_9 Need for information	2.97*	.19	.17	
	X_{10} Communciation	27.50*	.35	.52	

Table 4.1 (Continued)

DEPENDENT and Independent Variables[1]	"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_{13} OPERATING SYSTEM ROLE PERFORMANCE				.58
X_1 Building system role performance	.04	.00	-.02	
X_4 Uncertainty	7.10*	-.31	-.27	
X_6 Stress	.00	.01	.01	
X_8 Organizational autonomy	1.22	.19	.11	
X_9 Need for information	.73	.14	.08	
X_{10} Communication	.30	.07	.07	
X_{11} Rank	48.71*	1.11	.73	
X_{12} Norms	.41	-.14	-.09	

The next step is to convert the partial regression coefficient into standardized regression coefficients[1] or path coefficients. These values are added to the diagram of path Model I shown in Figure 15. The path coefficients are entered in the diagram near the dependent variables to which they refer. The path coefficients are presented in Table 4.2 along with their "F" values.

The Direct Effects of the Variables for Model I

Direct effects on operating system role performance

Model I was completed through the determination of significant paths. The completed Model I suggests two variables have a direct relationship with operating system role performance. The relative importance of these two variables can be evaluated through a comparison of the respective path coefficients found in Table 4.2, and noted on the path diagram found in Figure 15.

Rank has the greatest relative effect of the two variables that cause role performance. Rank has several times the effect of uncertainty, the second variable to effect role performance. It should be noted that the direction of the relationship between uncertainty and operating system role performance is opposite that of rank.

The network represented by these three variables has a combined effect in the prediction of operating system role performance. The multiple

[1] The standarized regression coefficients were obtained by utilizing the following formula:

$$\overset{*}{b}_{yx} = \frac{\Sigma x^2}{\Sigma y^2}$$

Table 4.2. Final determination of significant paths for Model I; all paths are significant at the .10 level

DEPENDENT and Independent Variables[1]	"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_5 ROLE CONFLICT				.27
X_1 Building system role performance	17.15*	.08	.48	
X_2 Disaster	7.16*	.38	.31	
X_6 STRESS				.23
X_2 Disaster	17.35*	.77	.48	
X_8 ORGANIZATIONAL AUTONOMY				.08
X_6 Stress	5.26*	.20	.29	
X_9 NEED FOR INFORMATION				.15
X_3 Warning	6.91*	.11	.32	
X_5 Role conflict	2.79*	.19	.21	
X_{10} COMMUNICATION				.05
X_6 Stress	3.08*	.26	.23	

[1]Each variable is a part of a network of variables that may be expressed as either independent or dependent variables. In this table, the dependent variable is identified by upper case type and independent variables by lower case type.

*"F" values significant at the .10 level.

Table 4.2. (Continued)

DEPENDENT and Independent Variables[1]	"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_{11} RANK				.20
X_1 Building system role performance	2.34*	.03	.18	
X_{12} Norms	10.92*	.41	.40	
X_{12} NORMS				.50
X_2 Disaster	2.57*	.22	.18	
X_6 Stress	2.93*	.15	.19	
X_9 Need for information	3.71*	.21	.19	
X_{10} Communication	27.53*	.35	.52	
X_{13} OPERATING SYSTEM ROLE PERFORMANCE				.56
X_4 Uncertainty	8.32*	-.30	-.26	
X_{11} Rank	66.34*	1.10	.73	

partial R^2 value was .56. In other words, the two variables impacting role performance explains 56 percent of the variance in operating system role performance. The two variables contribute significantly to the explanation of role performance in disaster.

Direct effects on norms

The completed Model I suggests four variables have a direct relationship with norms. The relative importance of these variables is evaluated through comparison of the respective path coefficients found in Table 4.2 and noted on the path diagram in Figure 15.

Communication has the greatest relative effect of the four variables that cause norms to emerge following the disaster. Communication has over two times the relative effect of the other variables. The other three variables to effect norms have the same relative effect. Need for information, stress and disaster are these variables.

The network represented by these five variables has a significant effect in the prediction of norms. The multiple regression R^2 value was .50. In other words, the four variables impacting norms explain 50 percent of the variance. The four variables contribute significantly to the explanation of the emergence of norms following a disaster.

Direct effects on rank

The completed Model I suggests that two variables have direct relationships with the rank of coordinator in the operating system. The relative importance of the variables are evaluated through comparisons of the respective path coefficients found in Table 4.2 and noted on the path diagram in Figure 15.

Norms has the greatest relative effect of the two variables that cause the increase in rank following the disaster. Norms has almost two times the effect of building system role performance.

The network represented by these three variables has a combined effect in the prediction of rank. The multiple partial R^2 value was .20. In other words, the two variables account for or explain twenty percent of the variance in rank. The R^2 value is fairly large and indicates that the two variables appear to have significant effects on the rank of coordinators following the disaster.

Direct effects on communication

One variable has a direct effect on communication in Model I and this variable is stress. The path coefficient is .23 which is found in the path diagram in Figure 15 or in Table 4.2. The multiple R^2 value was .05 which means that 95 percent of the variance is not explained. Possibly the items utilized for the measurement reflect only one facet of a more complex variable or that other variables not presently in the model should be considered in future research.

Direct effects on the need for information

Two variables have direct effects on need for information. These are warning and role conflict. The relative important was evaluated by a comparison of the path coefficients found in the path diagram in Figure 15 and in Table 4.2

Role conflict has the greatest effect on need for information compared to warning. Role conflict has almost one and a half times the effect of warning. The network represented by these three variables has a combined effect on the need for information following a disaster. The multiple R^2 value was .15. The two variables explain 15 percent of the variance in need for information. The R^2 value is relatively small. Possibly the items utilized for measurement reflect only one facet of a more complex variable or that there are other variables not presently in the model which should be considered in future research.

Direct effects on organizational autonomy

One variable has a direct effect on organizational autonomy. The variable is stress which has a path coefficient of .29 which is represented on the path diagram in Figure 15. The multiple R^2 value is .08. Only eight percent of the variance in organizational autonomy is explained by this variable. Other variables not in the model should be considered for future research, or the measurement utilized reflects only a facet of a more complex variable.

Direct effect on stress

The only variable determined to have a direct effect on stress is disaster severity. The path coefficient is .48 which is represented on the path diagram in Figure 15. The multiple R^2 value is .23. In other words, 23 percent of the variance of stress is explained by the severity of the disaster. The R^2 value is relatively large and severity of the disaster apparently significantly affects the level of stress. However,

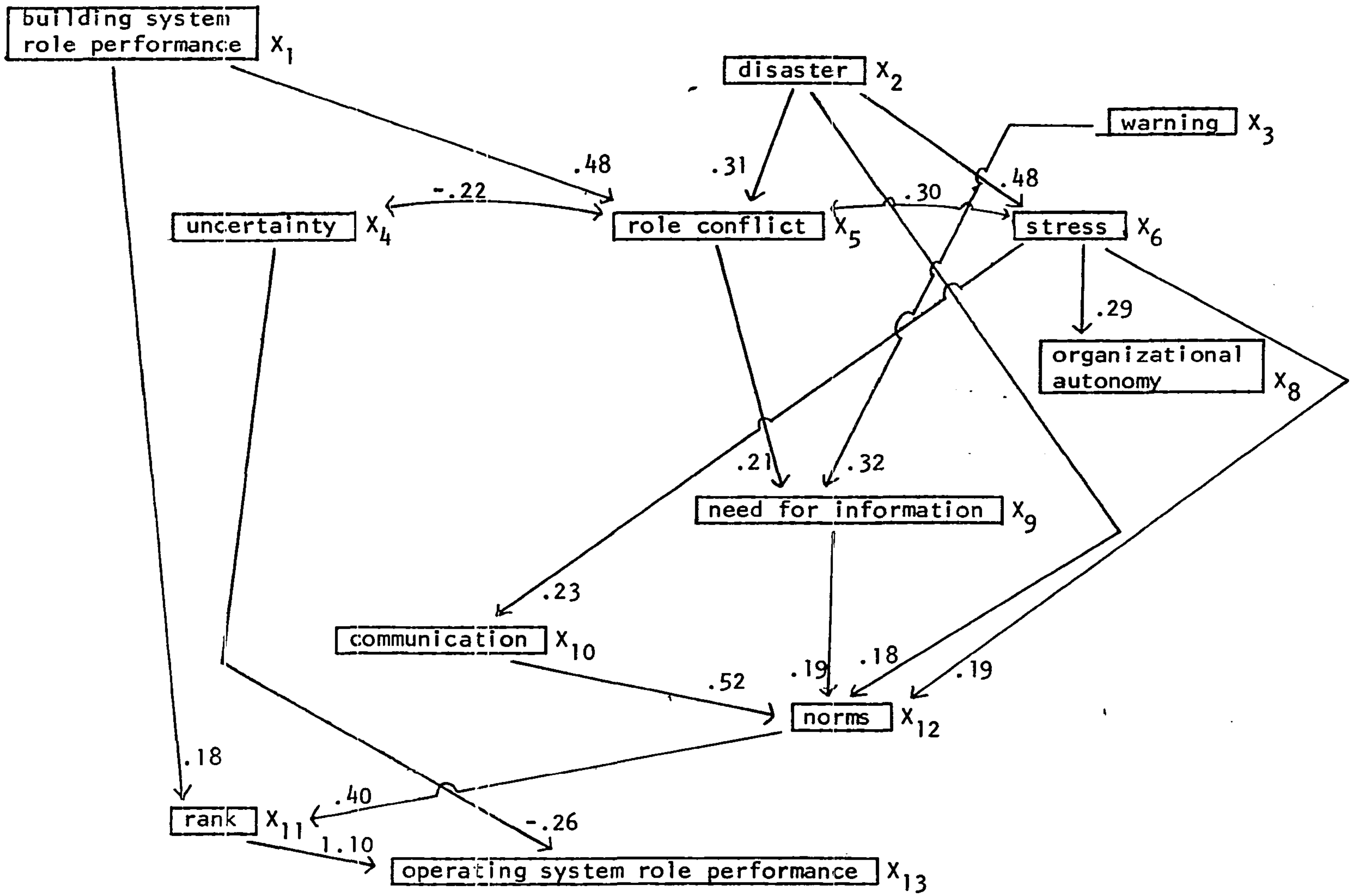


Figure 15. Path diagram for Model I with all paths significant but without residual paths.

in future research, other variables and better measurement procedures might be considered.

Direct effects on role conflict

Two variables were determined to have direct effects on role conflict. These two variables are building system role performance and disaster. The relative effects of these two variables were compared through inspection of the path coefficients found on the path diagram in Figure 15 and Table 4.2. The level of building system role performance was found to have more effect than disaster severity with the path coefficients being .48 and .31 respectively.

The multiple partial R^2 value was .27 which indicates that 27 percent of the variance in role conflict can be explained with these two variables which apparently have a significant effect on role conflict. As 73 percent of the variance is unexplained, improved measurement and inclusion of relevant variables might be considered for future research.

Findings for Model II

Model II is the least complex of the two models presented in that fewer variables were considered. The findings are presented for all significant paths in Table 4.4 and the path diagram in Figure 16. These findings are discussed in the following section in terms of direct effects of the variables. Generally, for Model II, nine of the 23 hypothesized relationships were supported by the data.

Determination of path coefficients for Model II

The identical procedures employed for Model I were utilized for Model II. The path diagram for Model II was developed in Chapter 2 and the recursive set of equations was introduced in Chapter 3. The partial regression coefficients for these equations in the initial determination of significant paths are represented in Table 4.3

The non-significant coefficients were eliminated and a new set of recursive equations were calculated. This procedure was repeated until all coefficients were significant at the .10 level. The coefficients were standardized in order to obtain the path coefficients or standardized regression coefficients. The modified recursive regression equations for Model II are as follows:

eq. 1 $X_7 = b_{72}X_2 + e_7$

eq. 2 $X_9 = b_{93}X_3 + e_9$

eq. 3 $X_{10} = b_{107}X_7 + e_{10}$

eq. 4 $X_{11} = b_{1112}X_{12} + e_{11}$

eq. 5 $X_{12} = b_{122}X_2 + b_{129}X_9 + b_{1210}X_{10} + e_{12}$

eq. 6 $X_{13} = b_{138}X_8 + b_{1311}X_{11} + e_{13}$

The path diagram for Model II with the significant path coefficients included is shown in Figure 16. The path coefficients, F value, R^2 value, and regression coefficients for the path diagram shown in Figure 16 are represented in Table 4.4

The Direct Effects of the Variables for Model II

Direct effects on role performance in the operating system

Model II was completed through the determination of all significant paths. The completed model suggests that two variables have direct effects on operating system role performance. The relative importance of these two variables can be evaluated through a comparison of the respective path coefficients found on the path diagram in Figure 16 or in Table 4.4.

The two variables are rank and organizational autonomy. Rank has the greatest relative effect. The effect of rank on operating system role performance is almost five times greater than organizational autonomy.

The network represented by these variables has a combined effect on operating system role performance. The multiple R^2 value was .51 which indicates that 51 percent of the variance in operating system role performance is explained by these two variables. The R^2 value is relatively large and indicates that the two variables have a significant effect on operating system role performance.

Direct effects on norms

Three variables have direct effects on norms. These are disaster, need for information and communication. The relative importance of these variables were evaluated through comparison of the relative magnitudes of the path coefficients found on the path diagram in Figure 16 or in Table 4.4.

Communication had the greatest relative effect. The effect of communication is approximately twice that of either disaster severity or need

Table 4.3. The determination of significant paths: Preliminary data analysis for Model II: Partial regression analysis

DEPENDENT and Independent Variables[1]	"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_7 SOCIAL DISORGANIZATION				.14
X_1 Building system role performance	2.32*	.07	.19	
X_2 Disaster	8.18*	.95	.36	
X_8 ORGANIZATIONAL AUTONOMY				.03
X_7 Social disorganization	1.98	.08	.18	
X_9 NEED FOR INFORMATION				.11
X_3 Warning	6.25*	.11	.32	
X_7 Social disorganization	.53	.04	.09	
X_{10} COMMUNICATION				.09
X_7 Social disorganization	3.20*	.16	.24	
X_8 Organizational autonomy	1.14	.23	.14	
X_9 Need for information	.03	-.03	-.02	

[1]Each variable is a part of a network of variables that may be expressed as either independent or dependent variables. In this table, the dependent variable is identified by upper case type and independent variables by lower case type.

*"F" values significant at the .10 level.

Table 4.3. (Continued)

DEPENDENT and Independent Variables	"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_{11} RANK				.22
X_1 Building system role performance	1.92	.03	.17	
X_7 Social disorganization	1.22	.07	.14	
X_{10} Communication	.01	.01	.02	
X_{12} Norms	5.06*	.36	.34	
X_{12} NORMS				.48
X_1 Building system role performance	1.03	.02	.10	
X_2 Disaster	6.31*	.33	.27	
X_7 Social disorganization	.17	.02	.04	
X_9 Need for information	4.54*	.23	.21	
X_{10} Communication	27.27*	.36	.53	
X_{13} OPERATING SYSTEM ROLE PERFORMANCE				.52
X_1 Building system role performance	.14	.01	.04	
X_8 Organizational autonomy	1.57	.08	.12	
X_9 Need for information	1.09	.18	.11	
X_{10} Communication	.02	-.02	-.02	
X_{11} Rank	39.02*	1.02	.67	
X_{12} Norms	.02	.03	.02	

for information. Disaster and need for information have path values which are close to the same magnitude with disaster severity having a slightly greater effect.

The multiple partial R^2 value is .47. The three variables that affect norms explain about 47 percent of the variance. The R^2 value is sufficiently large to indicate that the variables have a significant effect on norms.

<u>Direct effects on rank</u>

One variable was found to have a direct effect on rank. This variable, norms, has a path coefficient of .41 which can be located on the path diagram in Figure 16 or in Table 4.4. The multiple R^2 value is .17. Only 17 percent of the variance is explained with this set of variables. The R^2 value is such that in future research better measurement and the inclusion of additional relevant variables should be considered.

<u>Direct effects on communication</u>

One variable was found to have a direct effect on communication. This variable is social disorganization which has a path coefficient of .26 which can be located on the path diagram in Figure 16 or in Table 4.4. The multiple partial R^2 value is .07. Only seven percent of the variance in communication is explained leaving 93 percent unexplained. Better measurement techniques as well as the inclusion of additional relevant variables should be considered in future research.

Table 4.4. Determination of significant paths for Model II; all paths are significant at the .10 level

DEPENDENT and Independent Variables[1]	"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_7 SOCIAL DISORGANIZATION				.11
X_2 Disaster	6.77*	.86	.33	
X_9 NEED FOR INFORMATION				.10
X_3 Warning	6.66*	.11	.32	
X_{10} COMMUNICATION				.07
X_7 Social disorganization	4.10*	.18	.26	
X_{11} RANK				.17
X_{12} Norms	11.38*	.42	.41	
X_{12} NORMS				.47
X_2 Disaster	7.10*	.33	.26	
X_9 Need for information	4.44*	.23	.21	
X_{10} Communication	31.32*	.37	.55	

[1]Each variable is a part of a network of variables that may be expressed as either independent or dependent variables. In this table, the dependent variable is identified by upper case type and independent variables by lower case type.

*"F" values significant at the .10 level.

Table 4.4. (Continued)

DEPENDENT and Independent Variables[1]	"F" Value	Partial Regression Coefficient	Standardized Regression Coefficient (Path Coefficient)	R^2
X_{13} OPERATING SYSTEM ROLE PERFORMANCE				.51
X_8 Organizational autonomy	2.33*	.25	.14	
X_{11} Rank	54.10*	1.04	.69	

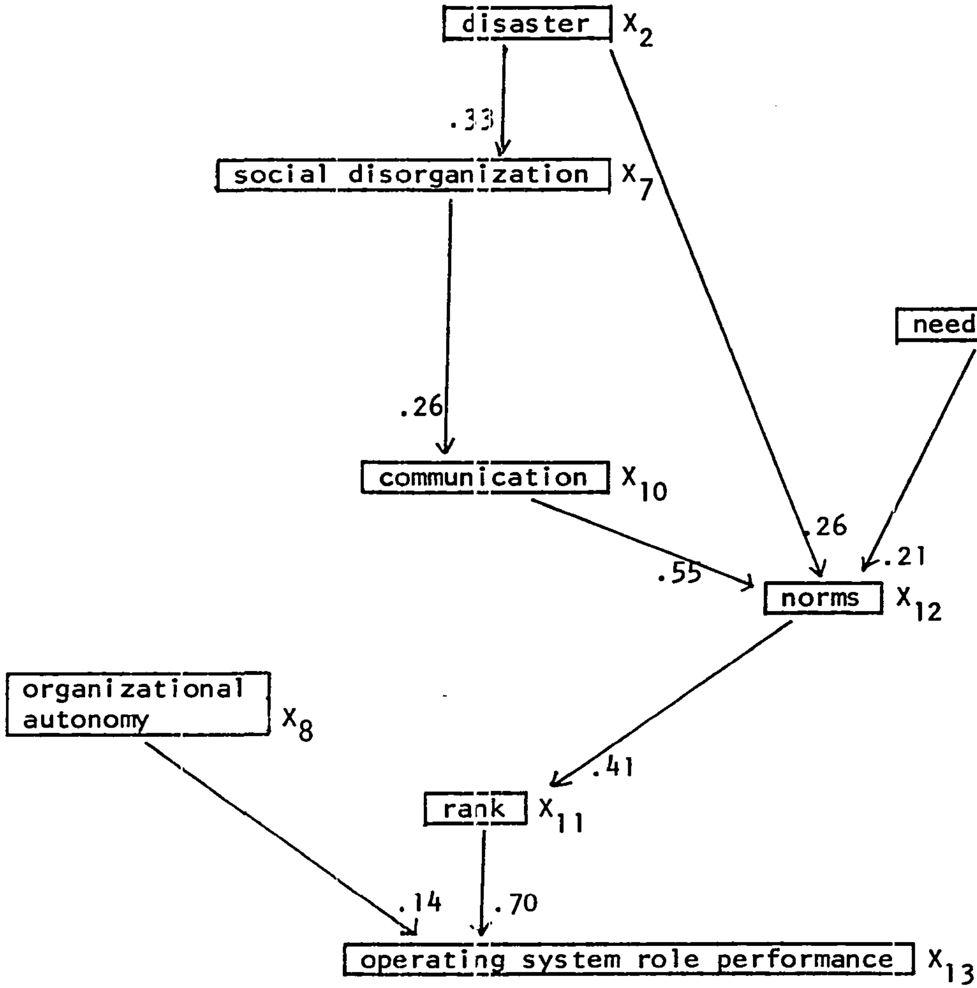


Figure 16. Path diagram for Model II with all paths significant at the .10 level without residual paths

Direct effects on need for information

One variable was found to have a direct effect on need for information. This variable is warning which has a path coefficient of .32 as found in the path diagram in Figure 16 or in Table 4.4. The multiple partial R^2 value is .10 indicating that ten percent of the variance in need for information has been explained and 90 percent unexplained by this set of variables. In future research, a concern with measurement and identification of additional variables is indicated as being desirable.

Direct effects on social disorganization

One variable was determined to have a direct effect on social disorganization. The variable is disaster severity with a path coefficient of .33 which can be located on the path diagram in Figure 16 or in Table 4.4. The multiple partial R^2 value is .11 indicating that 11 percent of variance was explained and 89 percent unexplained with this set of variables. In future research, a concern with measurement and with the inclusion of additional relevant variables is indicated as being highly desirable.

Quantification of Residuals

The effects of variables that are not included in the analysis or are not known are included in the residual value. A residual path, even though it has not been measured, may be added to the model if an endogenous variable has not been completely determined by variables in the model. None of the regression equations in Model I or Model II have variables included that are completely determined so the introduction of residual path coefficients are necessary. The residual path coefficient is estimated by the following formula (Land, 1969:16):

$$\text{residual path coefficient} = \sqrt{1 - R^2}$$

The residual path coefficient represents the square root of the portion of the variance of an endogenous variable that is caused by all the variables that have been left out of the model.

Residual paths for Model I

The residual paths were calculated for all variables in Model I not completely determined by endogenous variables. The coefficients are presented in Table 4.5 and introduced into the path diagram illustrated in Figure 17.

The effects of variables outside the model or the residual path are much greater than the magnitude of the path coefficient for most variables in the model as can be seen in a comparison of the residual path values with the path values. Role conflict, stress, organizational autonomy, need for information, communication and rank should be noted because of the large residual paths.

Probably the most adequate variables in the system are norms and operating system role performance. The residual paths are considerably lower for each of these variables. Also, it should be noted that for the operating system role performance, one path coefficient (rank) is larger than the residual path value. For both of these variables, 50 percent or more the variance is explained without consideration of the residual path value.

The conclusion suggested by examination of residual paths is that while many of the variables included in the model have significant causal effects on the variables, other variables have not been included and better

Table 4.5. Estimation of the residual path coefficients for Model I

Endogenous Variables	Modified Regression Equation No.	R^2	Residual Path Coefficient	Estimate of the Residual Path Coefficient
X_5 Role conflict	1	.27	Rr	.85
X_6 Stress	2	.23	Rs	.88
X_8 Organizational autonomy	3	.08	Ro	.96
X_9 Need for information	4	.15	Rn	.92
X_{10} Communication	5	.05	Rc	.98
X_{11} Rank	6	.20	Ra	.89
X_{12} Norms	7	.50	Rz	.71
X_{13} Operating system role performance	8	.56	Rp	.66

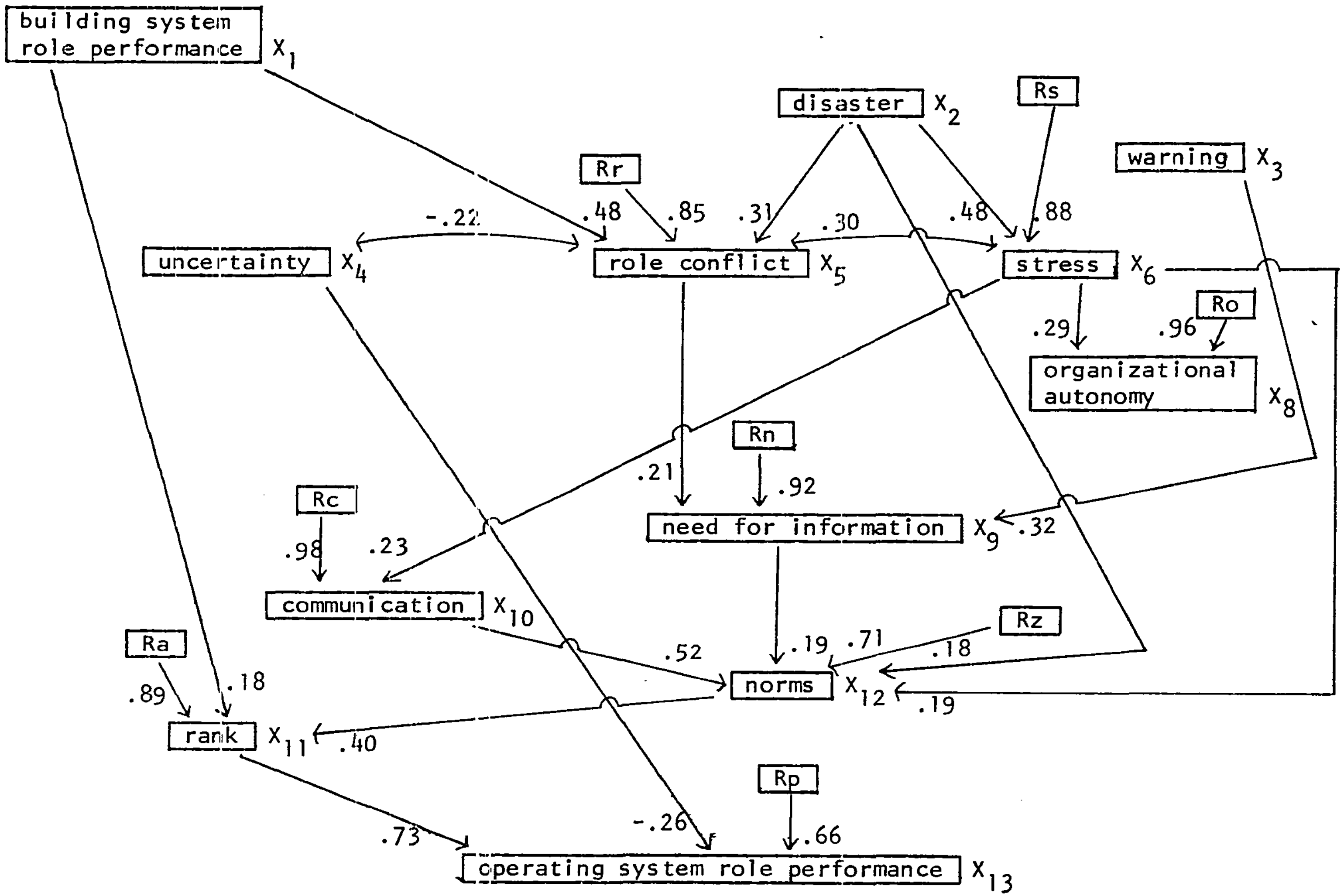


Figure 17. Path diagram for Model I with all paths significant plus residual paths.

measurement techniques should be attempted. Further research to bring the additional variables into the system is suggested.

Residual paths for Model II

Residual paths were calculated for all endogenous variables in Model II which were not completely determined. The coefficients are estimated in Table 4.6 and introduced onto the path diagram in Figure 18.

For most of the variables in the system, the effect of variables outside the model are much greater than variables in the model. This can be seen in a comparison of the residual paths with the magnitude of the path coefficients in the path diagram in Figure 18. Social disorganization, need for information, communication and rank should be noted because of the relatively large residual path values. The most adequate variables are operating system role performance and norms. For operating system role performance, one path coefficient is equal in magnitude to the residual path. Also, for both norms and operating system role performance, 47 and 51 percent of the variance in each is explained by the variables within the system.

The general conclusion is that while many of the variables within the causal system have significant causal effects, there are other variables which have been excluded and are not known. Additional research is indicated as necessary in order to include these additional variables as well as make possible the use of improved measurement techniques.

Quantification of the Indirect Effects

Land (1969) presented a procedure for determination of indirect effects of one of the variables on another variable in the model. Indirect

Table 4.6. Estimation of the residual path coefficients for Model II

Endogenous Variable	Modified Regression Equation No.	R^2	Residual Path Coefficient	Estimate of the Residual Path Coefficient
X_7 Social disorganization	1	.11	Rd	.94
X_9 Need for information	2	.10	Rn	.95
X_{10} Communication	3	.07	Rc	.96
X_{11} Rank	4	.17	Rr	.91
X_{12} Norms	5	.47	Rs	.73
X_{13} Operating system role performance	6	.56	Rp	.70

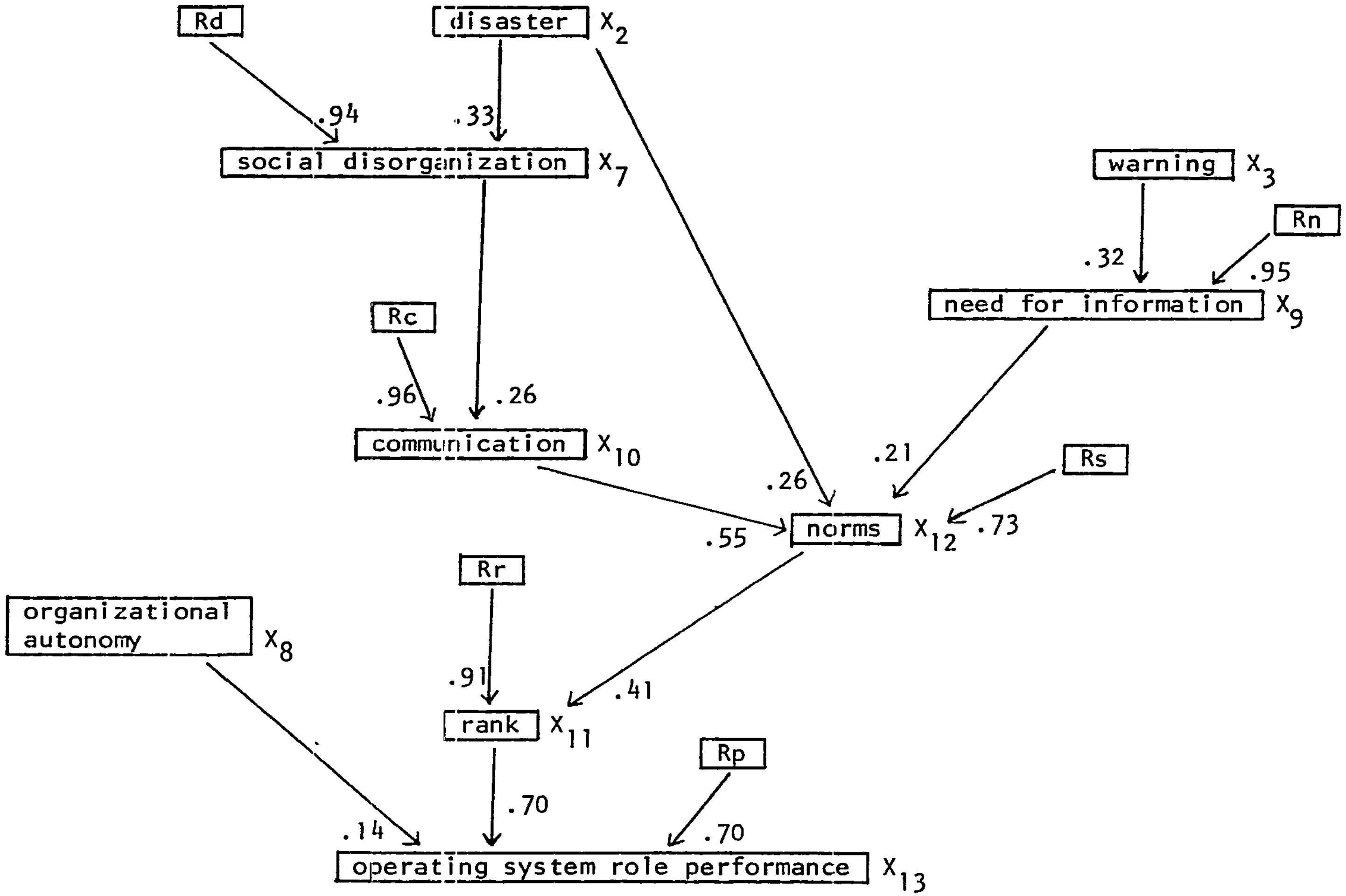


Figure 18. Path diagram for Model II with all paths significant with the inclusion of residual paths

Table 4.7. Intercorrelations in matrix form for all variables in Model I and Model II

Variable Number[1]	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
X_1	---												
X_2	-.178	---											
X_3	.063	-.064	---										
X_4	-.109	-.186	.154	---									
X_5	.224	.424	.005	-.217	---								
X_6	.483	.077	-.018	-.018	.300	---							
X_7	.326	.127	.084	.518	.510	.728	---						
X_8	.191	-.079	.082	-.057	.097	.291	.183	---					
X_9	.081	-.106	.323	-.101	.205	.144	.118	.165	---				
X_{10}	.125	.049	.016	.140	.075	.226	.259	.181	.030	---			
X_{11}	.040	.209	-.024	.100	.089	.282	.274	.088	.056	.265	---		
X_{12}	.350	.066	-.051	-.110	.269	.423	.310	.160	.246	.590	.408	---	
X_{13}	.012	.165	.086	-.185	.149	.238	.096	.204	.152	.195	.702	.320	---

[1]X_1, building system role performance; X_2, disaster severity; X_3, warning; X_4, uncertainty; X_5, role conflict; X_6, stress; X_7, social disorganization; X_8; organizational autonomy; X_9 information; X_{10}, communication; X_{11}, rank; X_{12}, norms; X_{13}, operating system role performance.

effects are calculated in order to identify relationships not apparent by examinations of direct effects or residuals. These are especially important if the effect of one variable is through an intervening variable. The Total Indirect Effects may be calculated through subtraction of direct effects from the total effect. Table 4.7 is utilized for calculation of the total indirect effect for both Model I and Model II. The total indirect effect may be partitioned providing there are other variables affecting the dependent variable.

The Total Indirect Effects (TIE) are calculated by solving equations for each endogenous variable in the system. These equations are in the following format as suggested by Land (1969) and utilized by Schmitz (1971), Paulson (1971) and Coward (1969).

TIE = TOTAL EFFECTS - TOTAL DIRECT EFFECTS

<u>Indirect effects for Model I</u>

The Total Indirect Effects for Model I are reported in Table 4.8. The indirect effect may be interpreted as a measurement of the effect of a variable on a second variable through an intervening variable. They often help identify important paths not previously considered especially when the effect is through intervening variables. The indirect effects for Model I are quite small. As a result, the determination of specific indirect effects by partialling the total indirect effects do not appear to be useful here.

The Total Indirect Effects reported in Table 4.8 for Model I and Table 4.9 for Model II are generally less than .10. The calculation of specific indirect effects would infrequently produce a value of practical

Table 4.8. Calculation of the Total Indirect Effects for the variables in Model I

DEPENDENT and Independent Variables	Total Effect (r)	Total Direct Effect (b*)	Total Indirect Effects (r-b*)
X_5 ROLE CONFLICT			
X_1 Disaster	.22	.48	-.06
X_2 Building system role performance	.42	.31	-.09
X_6 STRESS			
X_1 Disaster	.48	.48	--
X_8 ORGANIZATIONAL AUTONOMY			
X_6 Stress	.29	.29	--
X_9 NEED FOR INFORMATION			
X_3 Warning	.32	.32	--
X_5 Role conflict	.21	.21	--
X_{10} COMMUNICATION			
X_6 Stress	.23	.23	--
X_{11} RANK			
X_1 Building system role performance	.21	.18	.03
X_{12} Norms	.41	.40	.01
X_{12} NORMS			
X_1 Disaster	.35	.18	.17
X_6 Stress	.42	.19	.23
X_9 Need for information	.25	.19	.06
X_{10} Communication	.59	.52	.07

Table 4.8. (Continued)

DEPENDENT and Independent Variables	Total Effect (r)	Total Direct Effect (b^*)	Total Indirect Effects ($r-b^*$)
X_{13} OPERATING SYSTEM ROLE PERFORMANCE			
X_4 Uncertainty	-.19	-.26	.07
X_{11} Rank	.70	.73	-.03

Table 4.9. Calculation of the Total Indirect Effects for the variables in Model II

DEPENDENT and Independent Variables	Total Effect (r)	Total Direct Effect (b^*)	Total Indirect Effects ($r-b^*$)
X_7 SOCIAL DISORGANIZATION			
X_1 Disaster	.33	.33	--
X_9 NEED FOR INFORMATION			
X_3 Warning	.32	.32	--
X_{10} COMMUNICATION			
X_7 Social disorganization	.26	.26	--
X_{11} RANK			
X_{12} Norms	.41	.41	--
X_{12} NORMS			
X_2 Disaster	.35	.26	.09
X_9 Need for information	.25	.21	.04
X_{10} Communication	.59	.55	.04
X_{13} OPERATING SYSTEM ROLE PERFORMANCE			
X_8 Organizational autonomy	.20	.14	.06
X_{11} Rank	.70	.70	--

significance as they would tend to be even smaller in magnitude. Also, the residuals are relatively large suggesting measurement errors and calculation of indirect effects may only compound errors already present.

The largest indirect effect identified is that associated with norms through stress. This indirect effect is important in that it may indicate that further analysis may be necessary in order to identify the causal relationship between role conflict, uncertainty and stress. This factor could easily be considered in future research.

<u>Indirect effects for Model II</u>

Total Indirect Effects were calculated for Model II and are reported in Table 4.9. All indirect effects for Model II are extremely small. The average indirect effect is .056. Further analysis of the indirect effects does not appear to be necessary at this time.

A Comparison of Model I and Model II

Table 4.10 provides a summary of the criteria utilized to compare Model I and Model II. The overall criteria for comparison is the degree that the data "fit" the theoretical models introduced in Chapter 2.

The first criteria is the total number of relationships that were hypothesized. Model II (23 compared to 33) was the simpler of the two models in that fewer variables and fewer relationships were found in the model.

The second criteria is the number of relationships found to be significant and in the directions that were hypothesized. Seventeen of 33 relationships were significant in Model I and nine of 23 were significant in Model II. All of these were found to be in the direction as hypothesized as can be seen in Table 4.10.

The third criteria is a comparison of the relationships found that were hypothesized but in the opposite direction. It should be noted that no significant relationships of this type were noted in either Model I or Model II.

The fourth criteria refers to the total number of relationships found to be significant as hypothesized. In Model I, a total of seventeen (17) relationships were noted to be significant compared to nine (9) in Model II.

The fifth criteria is the percentage of the total number of relationships that were found to be significant. This figure refers to the total relationships found significant divided by the total number of relationships hypothesized. The figure that results might be viewed as a measure of "efficiency" (Paulson, 1971:120) of the model. In Model I, 52 percent of the hypothesized relationships were found to be significant. In Model II, 39 percent of the relationships were found to be significant. Model I might be viewed as a more "efficient" model in that it appears to more closely represent the relationships as noted in the theoretical model.

The sixth criteria is the identification of relationships that were not originally specified. It should be pointed out that no relationships were found that were not hypothesized. Future research may identify some of these relationships, especially in Model I as between stress, role conflict and uncertainty.

The seventh criteria is the estimate of the residual path coefficients for the dependent variable. Both Model I and Model II have similar

Table 4.10. A summary of Model I and Model II compared on the basis of eight criteria

Criteria for Comparison	Model I	Model II
1 - Total number of relationships hypothesized.	33	23
2 - Relationships significant in direction hypothesized.	17	9
3 - Relationship as hypothesized but in opposite direction.	0	0
4 - Total of the relationships as hypothesized.	17	9
5 - Percentage of the total number of relationships that were significant.	.52	.39
6 - Relationships found but not hypothesized.	0	0
7 - Estimate of the residual path coefficient for operating system role performance.	.66	.70
8 - Number of variables in the model.	12	9

residual path coefficients even though the residual for Model I is slightly less than the residual noted for Model II.

The eighth criteria is the number of variables in the model. There are 12 variables in Model I and nine in Model II. Model II appears to be much simpler in that fewer variables and fewer relationships are involved.

Both of the theoretical models appear to "fit" the data relatively well. However, it appears that if two models "fit," a decision on which is the better of the two might be based on simplicity. With the criteria of simplicity in mind, Model II is chosen over Model I. However, Model I should not be forgotten as it provides insights with the additional variables not provided by Model II. Model I is somewhat more "efficient" than Model II in that more of the hypothesized relationships in the model were found to be significant.

Correction for Attenuation

As noted in Chapter 3, a correction for attenuation was not employed before utilization of path analysis model building techniques. The purpose of this section is to correct for attenuation and compare correlations corrected for attenuation and those not corrected in order to determine if measurement error had an effect on the findings as reported in this chapter. Correction for attenuation is utilized to correct for measurement error but not for sampling error. Also, Heise (1969:68) points out that, in order to utilize correction for attenuation, the empirical correlations should be based on large samples and be precise. The sample size for the research reported in this dissertation is 59 which may be too small for precise estimates. Heise (1969:68) further points out that little is known about the hazards of the utilization of corrections for attenuation. The present writer, however, believes that the procedure should be considered for future articles or reports written through the utilization of the data from this dissertation, and it should be considered in future theory testing.

Correction for attenuation is accomplished through the utilization of the following formula (Bohrnstedt, 1969:123):

$$r^*_{xy} = \frac{r_{xy}}{\sqrt{r_{xx}\, r_{yy}}}$$

Where r^*_{xy} is the true correlation, r_{xy} is the observed correlation and r_{xx} is the reliability coefficient of x and y respectively.

The following formula is utilized when one variable of a correlated pair is measured by one item. Only one reliability coefficient is estimated and used to correct for attenuation. The formula is:

$$r^*_{xy} = \frac{r_{xy}}{\sqrt{r_{xx}}}$$

Where r^*_{xy} is the true correlation, r_{xy} is the observed correlation and r_{xx} is the reliability coefficient of one of the variables of the correlated pair. Each correlation presented was corrected for attenuation utilizing the formula presented above. The results are presented in Table 4.11 where correlations corrected for attenuation and those not corrected are illustrated for comparative purposes.

Evaluation of the amount of measurement error can be made by comparing correlations before correction for attenuation and correlations

Table 4.11. Intercorrelations in matrix form for variables in Model I and Model II with correlations corrected for attenuation above the diagonal and uncorrected correlations below the diagonal

Variable Number[1]	X_1	X_2	X_3	X_4	X_5	X_6	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
X_1	---	-.234	.078	-.142	.345	.680	.285	.140	.167	.065	.614	.018
X_2	-.178	---	-.067	-.204	.558	.092	-.100	-.154	.056	.290	.097	.212
X_3	.063	-.064	---	.159	.006	-.020	.099	.442	.017	-.031	-.072	.105
X_4	-.109	-.186	.154	---	-.282	-.021	-.072	-.153	.157	.137	-.159	-.234
X_5	.224	.424	.005	-.217	---	.422	.145	.353	.100	.143	.472	.226
X_6	.483	.077	-.018	-.018	.300	---	.399	.225	.276	.421	.671	.326
X_8	.191	-.079	.082	-.057	.097	.291	---	.275	.235	.140	.271	.300
X_9	.081	-.106	.323	-.101	.205	.144	.165	---	.045	.100	.473	.255
X_{10}	.125	.049	.016	.140	.075	.226	.181	.030	---	.373	.894	.256
X_{11}	.040	.209	-.024	.100	.089	.282	.088	.056	.265	---	.755	1.13
X_{12}	.350	.066	-.051	-.110	.269	.423	.160	.246	.590	.408	---	.542
X_{13}	.012	.165	.086	-.185	.149	.238	.204	.152	.195	.702	.320	---

[1]X_1, building system role performance; X_2, disaster severity; X_3, warning; X_4, uncertainty; X_5, role conflict; X_6, stress; X_7, social disorganization; X_8, organizational autonomy; X_9, need for information; X_{10}, communication; X_{11}, rank; X_{12}, norms; X_{13}, operating system role performance.

after correction. The average increase in correlation is .07. The variable, norms (X_{12}) evidenced the greatest change in correlations as a result of correction and uncertainty (X_4) appears to have changed least following correction. It should be noted that the correlation between rank (X_{11}) and operating system role performance (X_{13}) becomes greater than unity (1.13) following correction for attenuation. It appears that operating system role performance and rank: 1) have a common element and measure much the same thing, or 2) require better measurement techniques in future research. The rank of the coordinator appears relevant theoretically and should be separate from operating system role performance. Therefore, improvement in measurement techniques are indicated as being necessary in future research. However, in future research utilizing the data now available, it would appear necessary to combine rank and operating system role performance into a composite score. Correction for attenuation further suggested that measurement error has reduced the magnitudes of the correlations. Future research efforts should involve correction for attenuation before utilization of path analysis techniques in order to correct measurement errors.

Theory Testing

The models presented in this dissertation were discussed primarily in terms of building a theory to explain role performance following the impact of a disaster. The goal was to determine some relevant variables and the existence of path relationships and not the testing of theoretical path relationships or an estimation of the magnitude of the path coefficients. In order to accomplish the goal of theory building, the present research was regarded as exploratory, and the fit of the data with the theoretical models was discussed. The present researcher assumes that the goal of theory building was at least partially accomplished. It should be stressed that the testing of the theory built with the techniques utilized in this dissertation must be completed in future research. There are a number of ways that theory testing might proceed.

One method of theory testing is replication of the present study through a new research project. Another possibility is cross-validation procedures utilizing a split-measure and split-sample approach. These procedures would allow the use of data available for this dissertation for testing the model as a number of different items were utilized for most variables. It would not appear to be possible to utilize a cross-validation procedure based on splitting the sample utilized in the research. The sample size was 59 which would allow a very small sample size if split into two sub-samples for a cross-validation. Regardless of the techniques employed for testing the theoretical model, a correction for attenuation should be employed to better handle measurement error.

Summary

Chapter 4 was devoted to an analysis of the findings. Path analysis was briefly discussed as a technique for model building and was utilized to build a model of role performance in disaster by contributing to the identification of variables and significant relationships. Significant paths for Model I and Model II were established and discussed in terms of direct effects. Residual paths were estimated for both models and entered into the path diagrams. Their magnitudes were discussed in terms of their implication for the variables. Total Indirect Effects were calculated for each dependent variable. A comparison of Model I and Model II was attempted on the basis of eight criteria for comparison. Model II was chosen as the better of the two models chiefly on the basis of simplicity as both models appear to "fit" the theory even though Model I appeared more "efficient."

CHAPTER 5. IMPLICATIONS OF THE RESEARCH

Introduction

The purpose of this chapter is to explicate relevant implications in the following areas: 1) for theory, 2) for research methods and 3) for future research.

Implications for theory

Theory associated with formal or complex organizations has been primarily associated with the "normal" or building system activities of an organization and seldom with effectiveness. Concepts have generally been adopted which are associated with the system in its "normal" state but problems arise when this system is disrupted by some external or internal force. The operating system following the disruption has often been the province of collective behavior. A different set of concepts and propositions reflecting this perspective has sometimes been adopted to deal with the operating system.

However, one possible implication for theory is that the dichotomy (complex organizations versus collective behavior) may not be the most valid representation of what really happens in stress situations. A general systems approach allows one to link the two systems (building and operating), and it may be possible to link the two conceptual schemes associated with the "normal" and disaster or operating systems as well. The introduction of building system role performance as a variable that serves as an input to the operating system is useful. This building system variable can be identified, measured and predicted (Mulford et al., 1971 and Schmitz, 1971). Role performance is conceptualized as the link between the two systems.

A further implication is that disaster is only one type of stress situation even though it is often one of the most severe and obvious. Other types of stress occur frequently and regularly within and between organizations. It would appear fruitful to utilize the concepts identified through this research to analyze the changes that occur in other organizations as a result of change in the "environment" of the organization such as new legislation or new tasks being imposed external to the organization.

One major finding from this dissertation was that the two models that were utilized produce much of the same results in terms of the explanation of role performance following a disaster. The simpler model (Model II) in terms of fewer variables and number of relationships could be chosen as representing the better fit between theory and data chiefly because of its simplicity even though Model I was somewhat more "efficient." It appears fruitful and possible to develop models in this area, and further development of concepts and theory is needed and should be given high priority.

An assumption was made for the purposes of the research that the response to disaster followed an identifiable pattern regardless of the type of disaster agent encountered. There does appear to be such a pattern and the significant variables and their relationships can be identified, measured and related to each other. Further research, as well as concept and theoretical development, is urgently needed to further clarify the relationships among variables in the operating system. Also, research should be attempted to determine whether this assumption of a uniform pattern following disaster should be accepted or modified.

<u>Implications for research methods</u>

This research has focused on the response to disaster. Other researchers such as those at the Disaster Research Center at Ohio State University as well as others have dealt with this general area. However, there has been no known previous attempt to utilize the techniques incorporated in this dissertation even though Barton (1969) and Brouillette and Quarantelli (1969) have suggested the possibility of utilizing these techniques.

It would appear that survey research techniques have much to offer in the area of disaster research. The survey research techniques as utilized in this dissertation do not allow us to be on the scene immediately after the disaster, and we lose much of the vivid detail that this type of observation would allow. Much is gained through these techniques such as more adequate research design, measurement, sampling and some contribution to theory construction. The advantages offered by survey research techniques should be considered for future disaster research to gain the advantages they offer.

The researcher is able to gain increased precision in measurement with survey research techniques. The utilization of a structured interview schedule along with a concern with sampling allows the construction of scales for the variables and a search for relationships among the variables. In fact, it is with these techniques, as opposed to unstructured interviews, participant observation and case study that the theory of response to disaster will go much beyond the descriptive accounts of organizational response to disaster now characteristic of the field. An increased concern with precision of measurement is needed in disaster research.

The research techniques utilized in the dissertation emphasized quantitative data based on interview schedule responses of fifty-nine coordinators who assumed operational roles in disaster. Certainly this does not represent a large or representative sample. However, it should be pointed out that the sample is larger than is generally represented in disaster research. Often little or no concern has been given to sampling as the case study method was utilized with one or only a few organizations and individuals involved. In future research, the utilization of a random sample with a number of different coordinators and disasters would be an improvement. An increased emphasis in this area is necessary for theory testing and for generalization from the sample to the population. There will be problems in meeting this objective, but it is believed that it is possible and should be attempted.

This dissertation utilized a rather sophisticated statistical model building technique called path analysis. This technique allows relevant variables to be identified and their relationships specified. Previous disaster research utilized only simple statistics if they were utilized at all. An increased concern with sampling, research design and measurement will allow an increased emphasis on hypothesis testing as well as the various forms of model building and testing. An increased concern with statistical techniques, hypothesis testing and model building is suggested as needed for future research.

To summarize, it has been suggested that the methods utilized in this research offer a degree of sophistication not utilized before in disaster research. It was further suggested that these methods are appropriate for this area of sociology and should be pursued vigorously in the future in order to obtain the advances for theory through the advantages of adequate sampling, research design, precision in measurement and sophisticated statistical techniques.

Implications for future research

Most of this dissertation has been concerned with the specific research problem of explaining role performance in disaster. Future research would have the task of further explicating some of the implications of the present study utilizing more adequate sampling and research designs if new data were to be collected in the future. It has already been suggested that disaster research should give increased attention to adequate concepts, theory, statistical techniques, measurement, research design and multivariate techniques.

The present research had as one objective the building of a model of disaster role performance and emphasized the location of relevant variables and the specification of their causal relationship to each other. One future research goal should be to test the model which was constructed.

A second research goal should be the building of models that focus on other aspects of disaster response; namely, convergence, emergent norms and response to warning by the public. There appear to be many possibilities for research where the techniques suggested here could be utilized.

A third future research goal should involve the inclusion of organizations other than civil defense as the empirical arena. Red Cross, Salvation Army, police departments, fire departments and public utilities are some that might be considered to determine if the model is generally applicable to other organizations or agencies.

A fourth research goal revolves around the type of disaster utilized in the research. An assumption made for the purposes of this study was that the response to disaster was patterned and assumed in identifiable form with similar characteristics and problems regardless of the type of disaster agent. A possibility for future research is the investigation of the degree that this assumption is realistic. For example, the investigation of the differences in response to a tornado compared to a flood might provide useful insights.

A fifth research goal involves the utilization of models developed in this dissertation to investigate types of stress situations other than those associated with disaster. The question is whether a model of role performance in disaster is applicable to role performance in an organization in other types of stress or change situations. Can the set of concepts in this dissertation be utilized to explain role performance in organizations experiencing rapid change?

CHAPTER 6. SUMMARY

The general objective of this dissertation was to investigate the response to disaster through building of models of role performance. A real world problem was specified by reference to the impact of natural disasters. A general statement of the sociological problem was made through reference to past research efforts designed to understand response to disaster. The research reported in this dissertation differs in important respects from that of most prior disaster research. The differences were emphasized and explicated in an attempt both to specify the differences and clarify the nature of the present research.

Specific objectives for the research were specified in the Introduction and include: 1) the identification at a theoretical level of concepts which are related to role performance in an organizational response to environmental change, 2) the development of empirical measures of the relevant concept, 3) the empirical development of a causal model to explain role performance following a disaster, and 4) the discussion of some implications of the research as well as the suggestion of future disaster related research which might be considered.

In Chapter 2, a theoretical framework was introduced for the analysis of role performance following the impact of the disaster agent. A general orientation was presented to illustrate the relationship between the "building" and "operating" systems as well as the "vertical" and "horizontal" systems. These systems were presented as a means of linking the conceptual frameworks of collective behavior for the operating system and the frameworks of complex organization for the building system through the utilization of role performance as the major linking concept.

A review of the literature on response to disaster was presented in order to suggest issues, concepts and propositions. Two closely related models of role performance in disaster were introduced based in large part on this review of the literature. A number of concepts were introduced, nominally defined and relationships to other concepts were suggested through the utilization of verbal specification of relationships and diagrammatic presentations. Two models were developed through this process. The concepts and models were based on the available literature primarily from the Disaster Research Center publication. The purpose for building the models was the eventual explanation of operating system role performance as well as the identification of concepts and relationships to explaining behavior in the operating system. The following concepts were utilized in the construction of the models: building system role performance, disaster, prior warning, social disorganization, uncertainty, role conflict, stress, organizational autonomy, need for information, communication, norms, rank and operating system role performance.

In the preceding discussions, propositions and hypotheses were suggested. Fifty-six ordinary language propositions with thirty-six for Model I and twenty for Model II could be explicated verbally with two variables related to each other at a time. However, it should be pointed out that each of these verbal relationships would be a part of a system or a network of relationships. Little would have been served by a listing of all these relationships because of the networks that were developed. Figures 4 through 12 illustrated the development of propositions, and Figures

13 and 14 represent the two total models with all relationships specified. These figures represented the hypotheses to be tested.

In Chapter 3, the empirical setting was identified as the local civil defense agency in disaster related operations in the states of Iowa, Illinois, South Dakota and portions of Minnesota. A purposive sample of 59 local coordinators was drawn utilizing a phone screening interview schedule to locate those coordinators who had assumed the operational role following the impact of a disaster. The sample was all coordinators in Iowa, Illinois, South Dakota and Minnesota who had a disaster in their jurisdiction and who had assumed the operational role. The criteria utilized to choose operational coordinators included the following: 1) worked as coordinator within the sampling area, 2) jurisdiction had been declared a disaster area, 3) coordinator knew of the disaster declaration or of receipt of O.E.P. funds, 4) was still the local coordinator and 5) has assumed a role in recovery (as determined by a series of items to determine the activities engaged in by the coordinator).

Scales were developed for all but one of the variables (warning a one item variable). The certainty method or the ten-point continuum method of scoring was utilized for all variables except warning. To assess whether scales were obtained, empirical evidence such as intercorrelation of items and item-total scores were utilized. The major criteria utilized was additivity and external validation. Each variable was presented, defined and the scoring methods and items utilized to measure each of the variables were identified. Additional evidence for the scalability of the items was presented for each of the variables utilized in the dissertation.

The statistical technique of path analysis was introduced as the model building technique to be utilized for building a model of role performance in the operating system. The steps that are typically followed by the research in building models with this technique were presented and identified with the work in this dissertation. An initial set of recursive regression equations were developed for both Model I and Model II that were consistent with the theoretical models developed in Chapter 2. The assumptions as well as the advantages of path analysis were elaborated in order to clarify the nature of the statistical procedures being employed in this dissertation.

The research findings were presented in Chapter 4 of this dissertation. The findings for Model I were presented first in terms of the path analysis procedure for determination of significant paths. A modified set of recursive regression equations was presented to represent the causal models with all paths significant. The direct effects of the variables in Model I were described for each endogenous variable. The identical procedures were utilized for the alternative, Model II, in which all significant paths were determined, a modified set of equations were specified and direct effects discussed.

The residual paths were quantified and discussed for both Model I and Model II. The residual paths were included in the path diagrams for the models. The path diagrams for the models with all paths significant are presented in Figure 17 for Model I and Figure 18 for Model II.

The Total Indirect Effects of one variable indirectly on another were calculated to identify relationship not apparent by examination of direct effects and residuals. The indirect effects were quite small and did not justify further partialing of indirect effects or suggest many new paths for further consideration. One possibility for further research, however, is examination of the relationship between role conflict, uncertainty and stress. Model I and its alternative, Model II, were compared on eight criteria. Model II might be chosen over Model I because of its simplicity, but Model I was believed to be more "efficient" in comparison with Model II.

In Chapter 5, the implication of the research for sociological theory, for research methods and for future research were discussed. In terms of the implication of the research for theory, it was suggested that the dichotomy between the theory associated with complex organization and that associated with collective behavior may not be appropriate. A linking of the building or "normal" organizational system and the operating or "stress" system may be possible. A further implication is disaster is only one type of stress situation encountered by an organization, and the concepts utilized in this dissertation may be employed to explain behavior in differing types of stress situations. It was further suggested that the identifiable pattern, regardless of the type of disaster agent, is appropriate for further consideration, but more attention to concept and theory is urgently needed.

In terms of the implication for research methods, it was suggested that a number of advantages accrue to the researcher who utilizes the techniques employed in this dissertation. It was suggested that future disaster researchers should consider striving for better research designs, more precision in measurement, more adequate sampling and more sophisticated statistical techniques than have been utilized in past disaster research. In terms of the possibilities for future research, a number of possibilities and suggestions were made that would utilize the suggestion made earlier.

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APPENDIX A. BUILDING SYSTEM ROLE PERFORMANCE

Building system role performance was measured by the following items.

1. This technique emphasizes the development of clear-cut lines of authority. Each person or group is made to know his position in the official system. Coordination is established by providing rules for each person and organization.

   To what degree have you been using this type in day-to-day operations? In other words, to what degree have official rules been developed that help you coordinate with the fire department, police department, and so on.

2. The second type of coordination emphasizes the development and use of a plan. The local coordinator tries to develop disaster preparedness by encouraging government (and even non-governmental) groups and people to write plans for disaster. The coordinator may sometimes aid in the development of their plans and may also prepare an overall plan to coordinate the individual ones.

   To what degree have you <u>used</u> this type?

3. The third and final type of coordination emphasizes informal relationships. No official or legal lines of authority exist. Plans are not emphasized. Mutual adjustment and informal coordination are emphasized.

   To what degree have you <u>used</u> this type?

   Code:

01	02	03	04	05	06	07	08	09	10
not at all				moderately prefer					prefer very much

4. To what extent were you involved with each of these agencies in the development of their plan or annex? For each agency, circle the number which reflects your degree of involvement.

   a. police
   b. fire
   c. medical
   d. welfare
   e. public utilities

Code:

1 - No involvement

2 - Slight involvement

3 - Somewhat involved

4 - Much involvement

5 - Great involvement

APPENDIX B. DISASTER

Disaster was measured by the following four items.

Question Number	Questions or Items Utilized
1	Rate effect on traffic
2	Rate effect on disruption of government
3	Rate effect on overloaded hospital
4	Rate effect on essential community services

Code:

01	02	03	04	05	06	07	08	09	10
little effect				moderate effect					great effect

The total score or disaster score is the sum of the above four items.

APPENDIX C. WARNING

The extent of warning preceding a disaster was measured by the following item.

Question Number	Question or Item Utilized
1	Specify length of warning in hours

Code:

Number of hours, e.g.,

0000 - No warning

0001 - 1 hour or less

0010 - 10 hours

1000 - 1000 hours

The warning score is represented by the response to the above item.

APPENDIX D. UNCERTAINTY

Uncertainty is measured by the following five items.

Question Number	Question or Item Utilized
1	Departments of local government had anticipated the extent of the demands which would be made on them in order to recover from an emergency of the type which occurred.
2	During the recovery, it was known by civil defense that sufficient personnel were available to assist in the tasks which had to be done for the community to recover.
3	During the recovery, it was known by civil defense that other departments such as the police were operating in the area affected by the disaster agent.
4	During the early recovery period, it was known by local government officials that departments such as public works were operating in the impact area.
5	During the recovery, I was certain about what was expected of civil defense in the recovery operation for the community.

Code:

Agree, Certainty 5	A-5	00
Agree, Certainty 4	A-4	03
Agree, Certainty 3	A-3	05
Agree, Certainty 2	A-2	06
Agree, Certainty 1	A-1	07
Agree and Disagree	A and D	08
Disagree, Certainty 1	D-1	09
Disagree, Certainty 2	D-2	10
Disagree, Certainty 3	D-3	11
Disagree, Certainty 4	D-4	13
Disagree, Certainty 5	D-5	16

The total score or uncertainty score is the sum of the above five items.

APPENDIX E. ROLE CONFLICT

Role conflict was measured by the following five items.

Question Number	Question or Item Utilized
1	The first reaction of most people after being informed of the disaster was to personally attempt to help others by looking for survivors, administering first aid and cleaning up debris.
2	My first reaction after being informed of the disaster was to call a member of my family to see if they were indeed safe.
3	In my local civil defense jurisdiction, it was difficult to make decisions on which to do first: help restore essential services or work to maintain the morale of the public.
4	In my local civil defense jurisdiction, it was difficult to determine at first whether it would be desirable to help restore essential services or provide information to the public on the nature of the disaster.
5	To my knowledge, other department heads such as the fire chief contacted family or friends to check on their safety before directing their units in recovery operations.

Code:

Disagree, Certainty 5	D-5	00
Disagree, Certainty 4	D-4	03
Disagree, Certainty 3	D-3	05
Disagree, Certainty 2	D-2	06
Disagree, Certainty 1	D-1	07
Disagree and Agree	D and A	08
Agree, Certainty 1	A-1	09
Agree, Certainty 2	A-2	10
Agree, Certainty 3	A-3	11

Agree, Certainty 4	A-4	______	13
Agree, Certainty 5	A-5	______	16

The total score or role conflict score is the sum of the above five items.

APPENDIX F. STRESS

Stress was measured by the following six items.

Question Number	Question or Item Utilized
1	During the early hours following the disaster, I personally felt compelled to do something to help with recovery operations.
2	During the early hours following the disaster, I personally felt I was under a considerable amount of pressure.
3	During the recovery, the demands of my job as civil defense director became almost overwhelming and there did not seem to be enough hours in the day to get everything done.
4	During the recovery, the demands on operating personnel became so great that the needs could not be met by one department alone.
5	During the recovery, the demands on the police became so great that additional personnel and equipment were needed.
6	During the recovery, the demands on the public works department became so great that additional personnel and equipment were needed.

Code:

Disagree, Certainty 5	D-5	00
Disagree, Certainty 4	D-4	03
Disagree, Certainty 3	D-3	05
Disagree, Certainty 2	D-2	06
Disagree, Certainty 1	D-1	07
Disagree and Agree	D and A	08
Agree, Certainty 1	A-1	09
Agree, Certainty 2	A-2	10

Agree, Certainty 3	A-3	______	11
Agree, Certainty 4	A-4	______	13
Agree, Certainty 5	A-5	______	16

The total score or stress score is the sum of the above six items.

APPENDIX G. ORGANIZATIONAL AUTONOMY

Organizational autonomy was measured by the following four items.

Question Number	Question or Item Utilized
1	As the civil defense director, I or my representative made decisions affecting recovery without consulting other department heads in local government.
2	The police chief or sheriff took action and made decisions affecting recovery operations without consulting other department heads in local government or the chief executive.
3	The fire chief or his representative, after the disaster, made decisions and took action which affected recovery operations without consulting other department heads in local government or the chief executive.
4	As the civil defense director, I or my representative made decisions and took action without consulting other civil defense directors, state, regional or national personnel in civil defense.

Code:

Disagree, Certainty 5	D-5	00
Disagree, Certainty 4	D-4	03
Disagree, Certainty 3	D-3	05
Disagree, Certainty 2	D-2	06
Disagree, Certainty 1	D-1	07
Disagree and Agree	D and A	08
Agree, Certainty 1	A-1	09
Agree, Certainty 2	A-2	10
Agree, Certainty 3	A-3	11
Agree, Certainty 4	A-4	13
Agree, Certainty 5	A-5	16

The total score or organizational autonomy score is the sum of the above four items.

APPENDIX H. NEED FOR INFORMATION

Need for information was measured by the following six items.

Question Number	Question or Item Utilized
1	During the recovery period, I felt the need for information from friends or relatives.
2	After the occurrence of the disaster, I sought additional information on the extent of the impact by listening to radio or television.
3	Civil defense needed more information from departments such as the police and fire in regard to the extent of their activities in recovery operations, and this information was sought through personal contact with police and fire personnel.
4	During the recovery, civil defense needed more information on the activities of the public in attempts to recover from the impact of the disaster.
5	The public reacted to the disaster by attempting to contact others through the use of the telephone.
6	Many persons in my civil defense area reacted to the disaster by attempting to visit the scene of the disaster.

Code:

Disagree, Certainty 5	D-5	00
Disagree, Certainty 4	D-4	03
Disagree, Certainty 3	D-3	05
Disagree, Certainty 2	D-2	06
Disagree, Certainty 1	D-1	07
Disagree and Agree	D and A	08
Agree, Certainty 1	A-1	09
Agree, Certainty 2	A-2	10

Agree, Certainty 3	A-3 ______	11
Agree, Certainty 4	A-4 ______	13
Agree, Certainty 5	A-5 ______	16

The total score or need for information score is the sum of the above six items.

APPENDIX I. COMMUNICATION

Communication was measured by the following eight items.

Question Number	Question or Item Utilized
1	The plight of victims who were directly affected by the disaster was discussed with other heads of departments in local government.
2	The extent of property damage was discussed with persons from the impact area.
3	The extent of disruption in community life (loss of utilities, closing of schools, businesses, overloaded hospitals, loss of work, etc.) was discussed with department heads in local government.
4	Communication with other levels (state, regional or federal) in the Civil Defense system was increased during the recovery period.
5	Communication with upper levels of state or federal government was increased during the recovery period. (EXCLUDING THE CIVIL DEFENSE OFFICE AT THE STATE, NATIONAL LEVEL).
6	Once an emergency communications center became operational, it seemed to attract people other than those originally assigned there.
7	Once an emergency communications center became operational, it seemed to attract information from many departments and/or individuals.
8	Persons from the impact area attempted to contact the chief

executive of the local community
during recovery operations.

Code:

Disagree, Certainty 5	D-5 ______	00
Disagree, Certainty 4	D-4 ______	03
Disagree, Certainty 3	D-3 ______	05
Disagree, Certainty 2	D-2 ______	06
Disagree, Certainty 1	D-1 ______	07
Disagree and Agree	D and A ___	08
Agree, Certainty 1	A-1 ______	09
Agree, Certainty 2	A-2 ______	10
Agree, Certainty 3	A-3 ______	11
Agree, Certainty 4	A-4 ______	13
Agree, Certainty 5	A-5 ______	16

The total score or communication score is the sum of the above eight items.

APPENDIX J. RANK

Rank was measured by the following five items.

Question Number	Question or Item Utilized
1	As a civil defense director, I received increased importance during recovery from the disaster as compared to the period before the disaster.
2	The fact that I had information and knowledge as the civil defense director lead others to seek my help for problems they faced in their departments relating to recovery of the community.
3	The fact that civil defense had facilities such as an E.O.C., communications equipment, shelters, blankets, or food supplies lead others to seek help from civil defense.
4	Following the disaster, other local officials including the mayor began to look to civil defense to provide leadership in policy-making areas for recovery operations.

Code:

Disagree, Certainty 5	D-5 ______	00
Disagree, Certainty 4	D-4 ______	03
Disagree, Certainty 3	D-3 ______	05
Disagree, Certainty 2	D-2 ______	06
Disagree, Certainty 1	D-1 ______	07
Disagree and Agree	D and A ___	08
Agree, Certainty 1	A-1 ______	09
Agree, Certainty 2	A-2 ______	10
Agree, Certainty 3	A-3 ______	11
Agree, Certainty 4	A-4 ______	13
Agree, Certainty 5	A-5 ______	16

5	To what extent did the civil defense director, during the disaster in your jurisdiction, assume a leadership position which

was accepted by other departments
and service chiefs?

Code:

01	02	03	04	05	06	07	08	09	10
not at all				moderate extent					great extent

The total score or rank score is the sum of the above five items.

APPENDIX K. NORMS

Emergent norms were measured by the following six items.

Question Number	Question or Item Utilized
1	Before the disaster, some of the local officials had disagreements with each other, but during the recovery period, the differences were apparently put aside as the officials were able to work together for recovery of the community.
2	I found that it was necessary to improvise many of the activities necessary for my job during the recovery period as it was necessary to solve problems which had not been specified in advance of the disaster.
3	Informal meetings of community leaders occurred during the recovery period, and they made decisions affecting recovery operations and policy.
4	Informal relations with civil defense personnel at the state level were an aid in recovery in my jurisdiction.
5	The civil defense planning completed before the disaster contributed to operations in the recovery phase as useful equipment and supplies had been provided.
6	During the recovery period, civil defense publications, which I reviewed, helped me know what to do.

Code:

Disagree, Certainty 5	D-5 ______	00
Disagree, Certainty 4	D-4 ______	03
Disagree, Certainty 3	D-3 ______	05

Disagree, Certainty 2	D-2 ______	06
Disagree, Certainty 1	D-1 ______	07
Disagree and Agree	D and A ___	08
Agree, Certainty 1	A-1 ______	09
Agree, Certainty 2	A-2 ______	10
Agree, Certainty 3	A-3 ______	11
Agree, Certainty 4	A-4 ______	13
Agree, Certainty 5	A-5 ______	16

The total score or emergent norms score is the sum of the above six items.

APPENDIX L. OPERATING SYSTEM ROLE PERFORMANCE

The operating system role performance was measured by the following ten items.

Question Number	Question or Item Utilized
1	During the recovery phase, I, as the civil defense director, presented briefings to other individuals and department heads in the local government regarding the extent and nature of recovery
2	Civil defense monitored operational activities of other departments for responsiveness, adherence to policy and need for changes.
3	Volunteer operational personnel trained by civil defense were available and fulfilled their responsibilities when the disaster occurred.
4	I advised others in the local government such as department heads and the mayor regarding the activities they might undertake to contribute to recover from the effects of the disaster.
5	I worked directly with operational personnel by looking for survivors, giving first aid, building sandbag dikes, damage assessment, setting up road blocks, etc.
6	I met with department heads and through negotiation arrived at decisions which affected recovery operations.
7	The civil defense director was responsible for making decisions which affected recovery operations, but the decisions often required action by others such as the chief executive of the local government to make the decision seem legitimate.

8 Civil defense attempted to help other local officials keep the public informed about the recovery operations.

Code:

Disagree, Certainty 5	D-5 ______	00
Disagree, Certainty 4	D-4 ______	03
Disagree, Certainty 3	D-3 ______	05
Disagree, Certainty 2	D-2 ______	06
Disagree, Certainty 1	D-1 ______	07
Disagree and Agree	D and A ___	08
Agree, Certainty 1	A-1 ______	09
Agree, Certainty 2	A-2 ______	10
Agree, Certainty 3	A-3 ______	11
Agree, Certainty 4	A-4 ______	13
Agree, Certainty 5	A-5 ______	16

9 To what degree have you used this type in recovery operations? In other words, to what degree were official rules developed that helped you coordinate with the fire department, police department, and so on during the recovery operations.

10 To what degree have you used this type in recovery operations?

Code:

01	02	03	04	05	06	07	08	09	10
not at all				moderately prefer					prefer very much

The operating system role performance score is the sum of the above ten items.

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